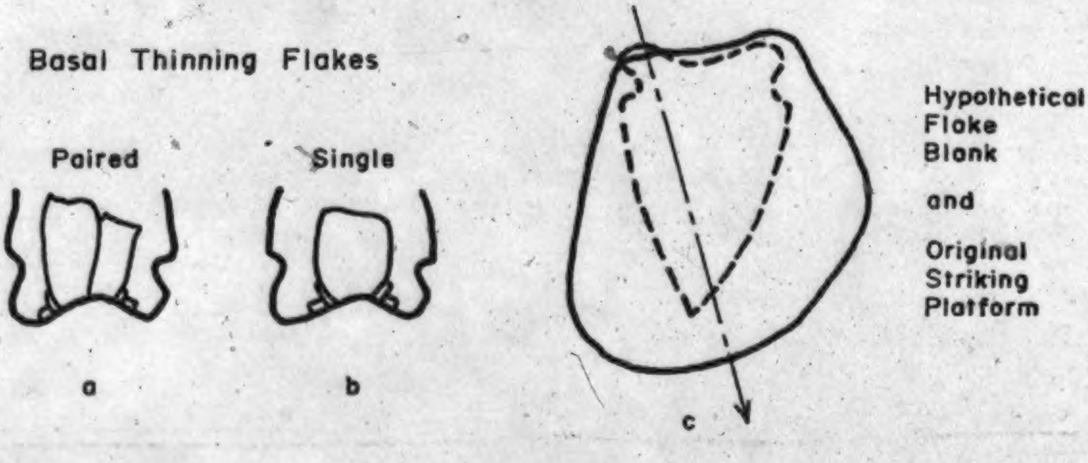


Fig. 11 - Projectile Point Basal Thinning Flakes and Remnant of Striking Platform from Original Blank.

cidentally, the blade was thinned from both sides in the intended notch area. Next, the thinned area could have been bifacially retouched until the edge was too steep for further chipping. By that time the notch would have been complete. It seems more likely, however, that after lateral edge thinning, the balance of the notch was removed by crushing the thinned edge. Crushing would produce the minute hinged fracture scars and the abraded edge, which is usual within a notch, all in one operation.

Edge abrasion (grinding). By edge abrasion is meant some kind of rubbing process by which certain segments of the sharp edges of points were worn down to dull them. It seems likely that edge abrasion was purposefully done around the notches and along the basal edge as it is quite evenly spread over those edges, a phenomenon that seems unlikely if abrasion was accounted for by a loose point rubbing within its haft. Edge abrasion could have been done quickly by rubbing an abrasive stone, such as a sandstone, back and forth a few times along the edge one wished to dull. Purposes suggested for edge abrasion (or grinding) include dulling the haft edge so that it would not cut the sinew string that bound it to the shaft of the arrow; and dulling the basal edge so that on impact, the point would not split the shaft (cf. Wormington 1957:38; Crabtree 1974). These explanations fit with the observed distribution of edge abrasion on Harder site projectile points. Ten of the 24 specimens exhibit clear edge abrasion. In all cases the abrasion occurs along the whole basal edge from the proximal point of one notch to the proximal point of the other. Usually the heaviest abrasion occurs on the outside segments of the basal edge along the 'ears'. Continuing along the lateral edge, the interior edge of the notch is dulled; but, as already noted, this feature is probably due to crushing during notch making. Some points also show a little edge abrasion on the lateral edge extending from the distal point of the notch 2 or 3 mm toward the tip. The balance of the lateral edge to the tip is either sharp or broken off.

Of the remaining 14 unabraded specimens, six appear to be new unfinished points and two appear to have been undergoing basal repairs at the time of deposition. This total leaves six points with unabraded edges but an otherwise functional appearance. All six are small points, the smallest found in the site, yet chipping scars are as complex as the others, except for two which exhibit parts of their original flake blank surface indicating that they are of new manufacture and were made small to begin with. Whether or not these points were functional hunting projectile points could be tested by finding or not finding similar ones among large collections of projectile points among bones at kill sites.

Sequence of chipping operations. The following sequence assumes at initiation a projectile point preform: (1) The lateral edges and tip of the finished point remain the same as those of the preform; (2) The basal thinning flakes are removed; (3) The notches are made; (4) Certain segments of the edge are abraded and the point is complete. The evidence for this sequence was determined by analyzing the sequence from overlapping flakes on the complete projectile points. Crucial flakes do not overlap on all specimens, but given a sufficiently large collection of specimens or a particularly good specimen the sequence can be fitted together.

Repairs to broken projectile points. Projectile points at the Harder site appear to have been broken during initial manufacture, during use, and during repair. It is possible that repairs might have been made to broken projectile points in any of the three states if the broken remnant was sufficiently large to allow further reduction by chipping and if the material was sufficiently unfaulted and thick enough to permit further work. If repair called for modifications to all elements of the projectile point, not just the broken area, it would be difficult to separate complete unrepaired points from complete repaired ones, except by size. Small points might be taken as being the end result of repairs to larger broken points. But if the original starting size (preform size) varied, then smallness in a projectile point could not be taken as an indication of repair.

On the other hand, if repair meant only modification of the broken area, then the proportions of the elements of a point would change with respect to each other during repair, or, more correctly, one element would change while the others would not. For example, if only the tip was repaired and the rest left the same as before, the total length would be reduced but the width would remain the same. One complete point shows such a disproportional arrangement of elements quite clearly (see Plate 17m). This point has the greater volume of stone in the base below an imaginary line joining the distal points of the two notches rather than above that line to the tip. This proportion is opposite to the usual situation where the bulk of stone is found between the notches and tip. Repairs to a broken tip seems the obvious explanation for the disproportion in this case.

Although projectile points in the Harder site have been observed to have several parts broken off, I have noticed repairs only to broken tips, not to any other breaks. This fact has a bearing on the problem of identifying repaired points. One can examine the relations of certain measurements of points and then generalize about whether repair meant overall modification to the point or simply modification to the broken tip. If repairs to the tip were accompanied by modifications to the notches and base, the result would be a smaller point with the same length/width ratio as before its tip was broken off. If, however, only the tip area was modified, then the overall length would be reduced while the width would remain the same. Consequently, the length/width ratio would be changed. Variation in initial starting size does not significantly affect such a ratio.

The lengths and widths of 24 Harder site projectile points are plotted against each other in Fig. 12. Included are only those artifacts which are complete and could be measured directly, and those that are so nearly complete that the estimate of a dimension is virtually as reliable as an actual measurement. There is a tendency for projectile point width to hover between 18 to 22 mm, while at the same time length varies from

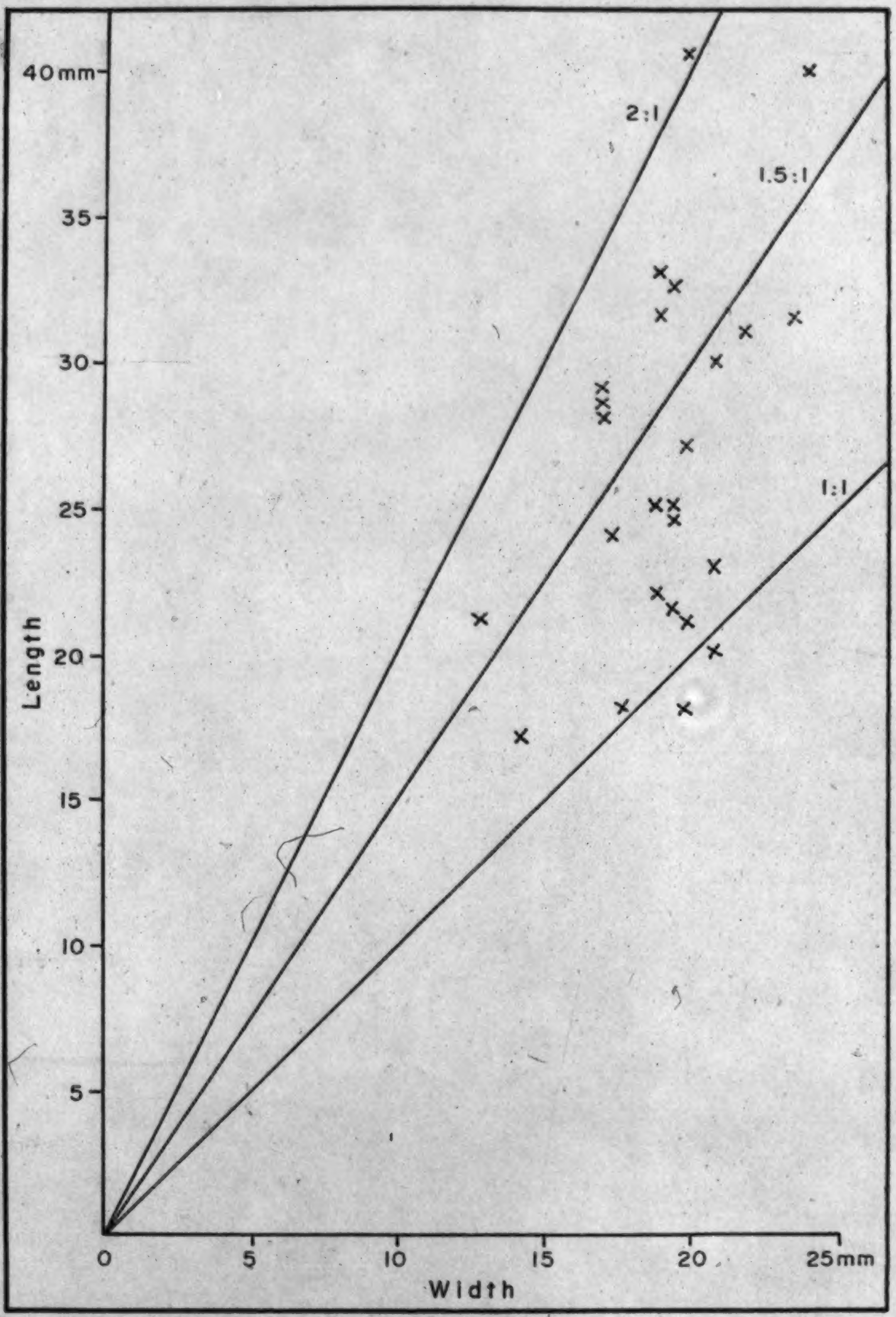


Fig. 12 Projectile Point Length Plotted Against Width.

18 to about 41 mm. This tendency indicates a changeable length/width ratio due to variation in length much more than variation in width. Consequently, it appears repairs tend to affect only the tip. One also notices in this graph that in many cases the points are only a little longer than they are wide. In some cases length and width are nearly the same. This feature could be expected from an exhausted collection of projectile points which were beyond the point of further repair.

Broken projectile points are only of value to an investigation of repair techniques if repairs have been started on them. A few points from the Harder site have been discarded part way through the process of chipping repair. In one instance (see Plate 17a), repairs toward retipping a large fine-grained chert point had just begun. Three broad shallow flakes had been removed from one side of one edge, thus beginning the reduction of the lateral edge by the width of the striking platforms of the three removed flakes. Obviously, if this chipping had been continued from one face to the other, on both lateral edges, and with more flakes being taken from the tip end than from the notch end of the lateral edges, before long the lateral edges would have been reduced to the point that they once again converged at a tip. But in this case the process was abandoned after the removal of only three flakes. The reason is not apparent, in any case this point allows me to hypothesize that the general technique for repairing a broken tip involved removal of a series of broad shallow flakes from the lateral edges until the edges once again converged at a tip. Then, presumably, as in initial manufacture, the curvature of the edge was smoothed by removing the ridges between broad flakes with narrow finishing flakes. The short retipped point previously mentioned shows the use of such narrow finishing flakes.

Distribution in the Site. The horizontal distribution of all chipped stone tools excavated at the Harder site is shown in Fig. 13. Tools both complete and broken, were widely scattered. They occurred both inside and outside concentrations of other elements. The greatest concentration of stone tools was in adjoining excavation units Ow015s and Ow5n, which is the centre of Feature 9.

The vertical distribution of all chipped stone tools excavated at the Harder site has been tabulated relative to three arbitrary sub-zones, within the single Oxbow component. The first sub-zone is a layer up to 5 cm thick resting on the top of the Oxbow component. The second sub-zone is the middle of the Oxbow component, varying from 8 to 10 cm in thickness. And the third sub-zone is a layer 5 to 20 cm. thick, the bottom of the Oxbow component. The number of whole and broken tools found in each sub-zone is shown in Table VIII. It will be noted that nearly half of the projectile points appeared at the top of the Oxbow component. It is no surprise to discover a large number of projectile points in the middle component and even a few pushed below, but it is surprising to find so many at the very top. If this vertical arrangement can be taken as a reflection of internal chronology within the occupation, it would appear that projectile points played a large part in the very last activities of the occupation. This fact might be explained as a concerted rejuvenation of the arrowheads expended during the hunting period of the Harder occupation. One of the things that would have to be done prior to moving the camp to a new hunting area would be the repair of hunting gear, hence the concentration of rejected projectile points at the top of the component.

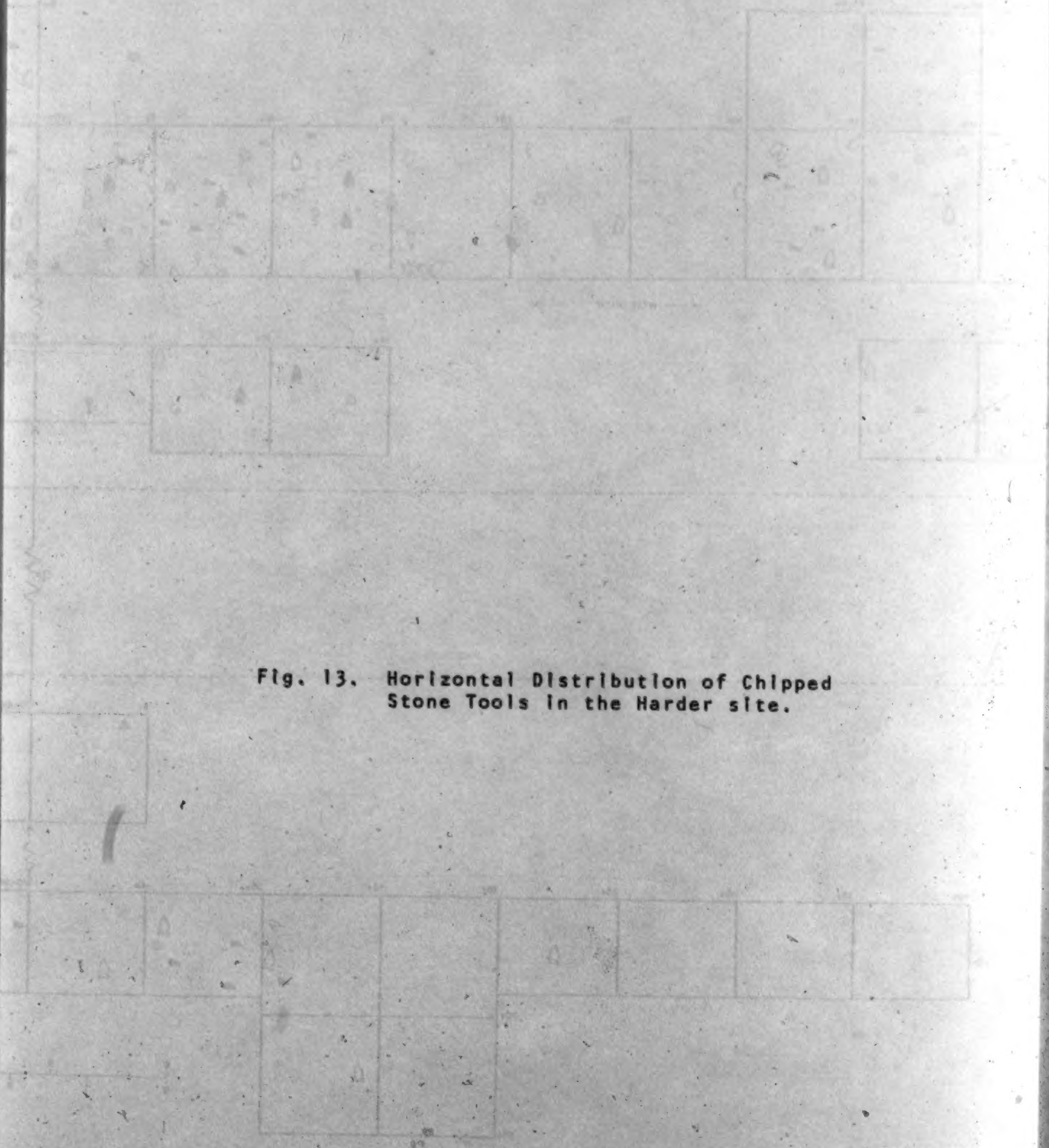
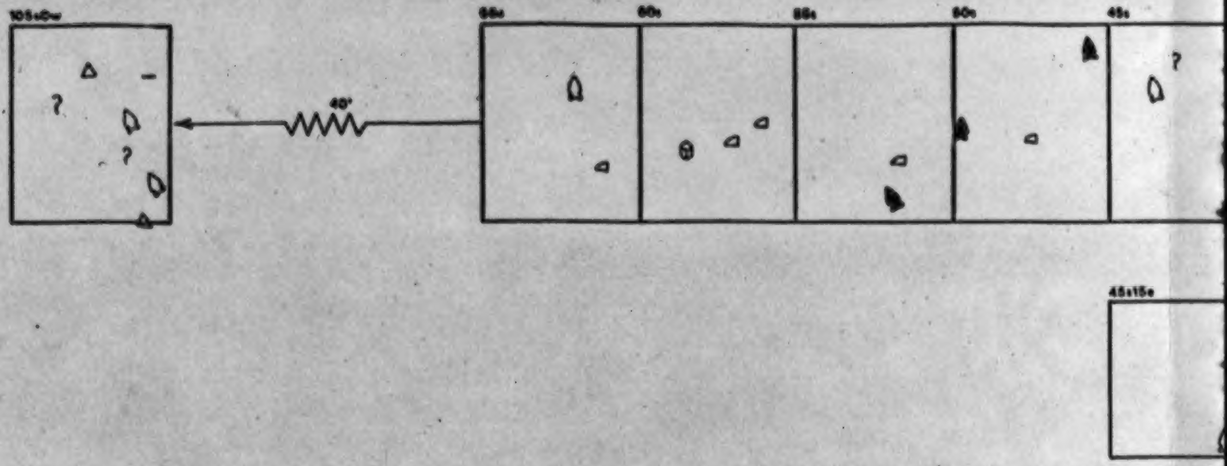
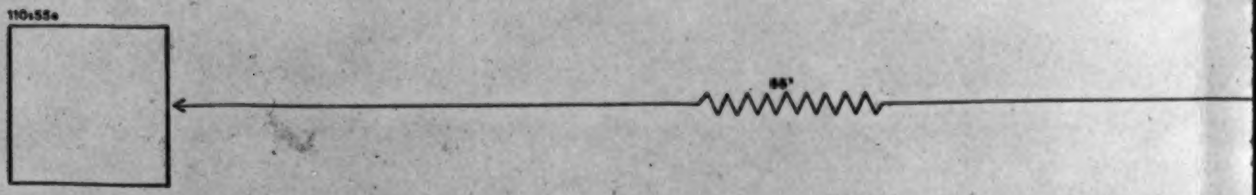
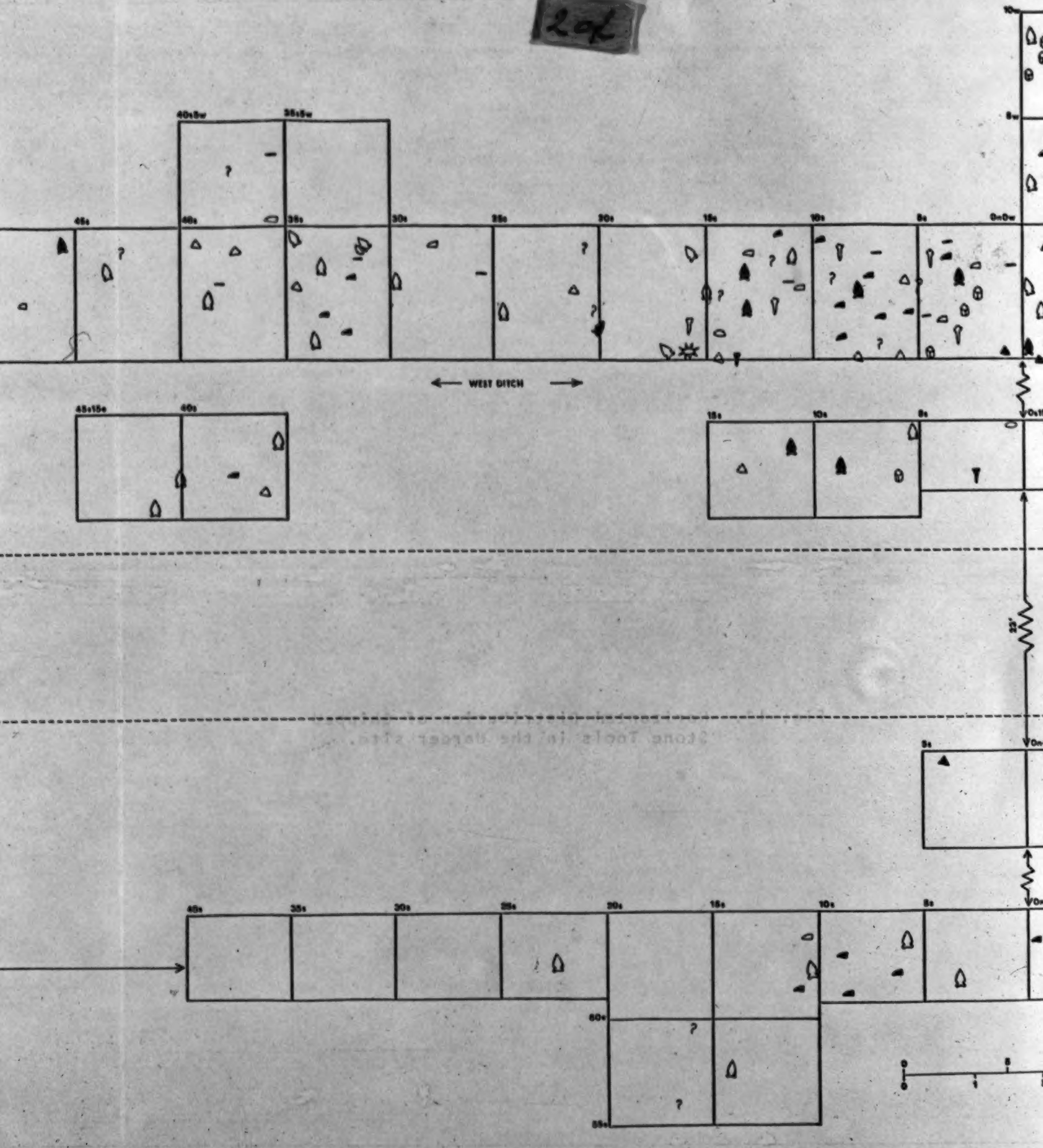


Fig. 13. Horizontal Distribution of Chipped Stone Tools in the Harder site.


105s0w
?
?
40°
65s
60s
55s
50s
45s
?
45s15e

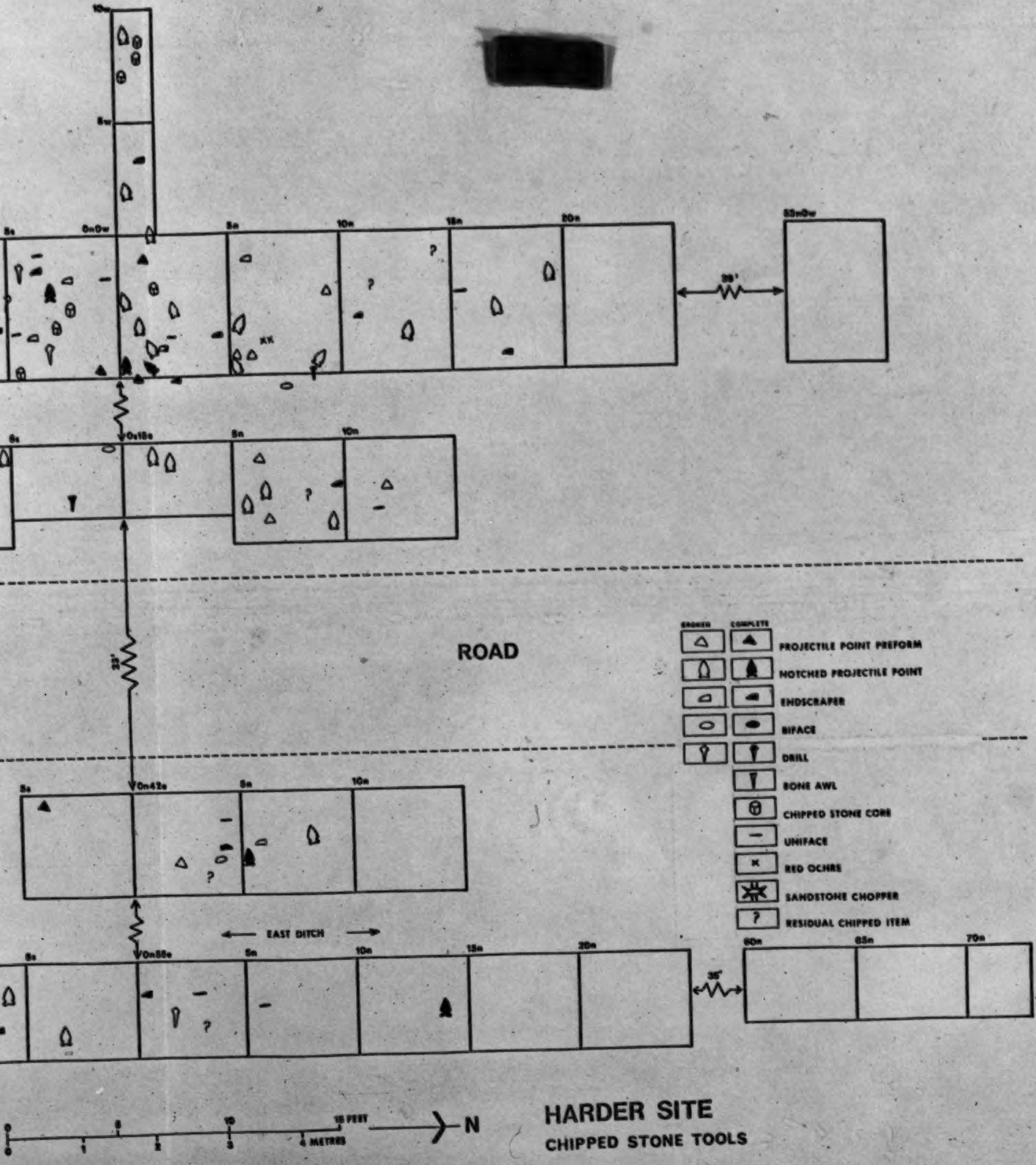

110s55e
65°

2 of



10w
5w
40s5w
35s5w
45s
40s
35s
30s
25s
20s
15s
10s
5s
0s0w
WEST DITCH
45s15e
40s
15s
10s
5s
25'
5s
45s
35s
30s
25s
20s
15s
10s
5s
60s
55s
0
5
0
1

[redacted]


10w
5w
5s
0n0w
5n
10n
15n
20n
55n0w
35'
0s18e
5s
5n
10n
ROAD
33'
0n42e
5s
5n
10n
EAST DITCH
0n58e
5s
5n
10n
15n
20n
35'
60n
65n
70n
BROKEN
COMPLETE
PROJECTILE POINT PREFORM
NOTCHED PROJECTILE POINT
ENDSCRAPER
BIFACE
DRILL
BONE AWL
CHIPPED STONE CORE
UNIFACE
RED OCHRE
SANDSTONE CHOPPER
RESIDUAL CHIPPED ITEM
0
5
10
15 FEET
0
1
2
3
4 METRES
N

HARDER SITE
CHIPPED STONE TOOLS

TABLE VIII

Vertical Distribution of Chipped Stone Tools

Class	Zone 1	Zone 2	Zone 3
Projectile Points	29	24	8
Projectile Pt. Preforms	7	10	2
Perforators	0	2	0
Small End Scrapers	11	23	1
Thin Uniface Knives	6	8	1
Biface Knives	1	3	1
Residual Retouched Items	6	11	2
TOTALS	60	81	15

Projectile Point Function. The long established notion that sharp-pointed bifacially chipped pieces of stone with some sort of haft element once served as the tip of a wooden (or possibly bone) projectile is an interpretation that is accepted here. Whether these points served as tips for arrows, atlatl darts, or spears is not clear. Considering the great range in size between the largest and smallest specimens it is possible that all three types of projectiles were in use at this site.

It is conceivable that projectiles may have served the purpose of knives as well. The pressure that occasional knife-use would have exerted on the binding of a projectile point may be one reason that the lateral edges and base were smoothed. One presumes that if projectile points had been used extensively as knives then the lateral edges and tips of some points should be worn or polished due to this use. Examination of the Harder site points for this type of wear, however, proved inconclusive.

The most noteworthy feature of the Harder site projectile points is the disfunctional state in which they were discarded. The 49 fragments of tips, mid-section, and bases are obviously beyond repair or any further use. The conclusion that the 'complete' points were also discards, while not so obvious at first glance, became obvious during the analysis of chipping and repair. The complete and nearly complete points display a variety of shortcomings. The nearly complete ones all have some breakage; usually a small part of the tip is missing, but occasionally it is a piece of the base (ear) that is gone. Out of 10 points which are complete as far as parts go, one is exceedingly small, one has a distorted shape due to material, one is small with very blunt edges all round, three have only the broad shallow flakes giving the appearance that they had been quickly roughed out but not finished, two are very short with an unusually small amount of stone between the notches and tip - no doubt the tips have been repaired but the reduction of the blade has been so severe that the points were probably no longer functional and, finally, two points are finely finished with only one small nick each on the lateral edge near the tip - out of the whole collection probably only these two were functional. In summary, the collection of projectile points left at the Harder site is biased toward the disfunctional extremities of the total range of Oxbow projectile point variation.

Class 2. Projectile Point Preforms. (N=22) (see Plate 19)

Form. The class, projectile point preforms, is comprised of small bifaces with a straight or slightly concave basal edge and two gently curving lateral edges which converge at a tip. Preforms resemble projectile points except they lack notches and have bases that are usually only slightly concave and sometimes straight. The widest part of the blade is located in the lower third of a specimen near the base. Longitudinal cross-section is usually biplano or irregularly biconvex. All but two of the specimens were either broken or unfinished. Fig. 14 shows the elements and points of measurement of a schematized projectile point preform from the Harder site.

Basic Dimensions. The basic dimensions of projectile point preforms are the maxima of length, width, thickness, and weight measured as shown in Fig. 14. Measurements of these basic dimensions together with the material, colour, and provenience of each specimen are recorded in Table IV. The average length, width, thickness and weight is also shown in Table IX. If these measurements are compared to those of the complete projectile points (see Fig. 15), it is seen that the two classes are essentially parallel to each other, with projectile point preforms being only slightly longer, wider, thicker, and heavier than projectile points.

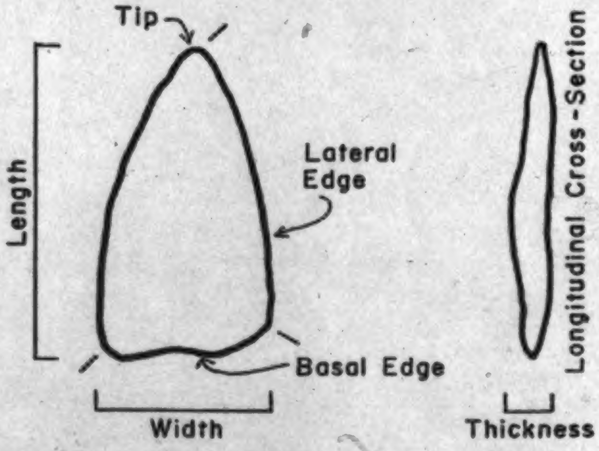


Fig. 14 - Elements and Measurements of Projectile Point Preforms.

TABLE IX

Basic Dimensions and Other Attributes of Projectile Point Preforms

Specimen	L (cm)	W (cm)	T (cm)	Wt (gr)	Stone	Colour	Prov.	Plate
1	a3.0 b3.9	2.2	0.7	4.7	pet wood	olive-brown	0w5n	19a
2	3.7	a2.3 b2.5	0.8	4.1	pet wood	light-brown	0w35s	19b
3	a2.5 b5.0	2.4	0.5	3.9	pet wood	olive-tan	0w20s	19c
4	2.7	2.0	0.4	1.9	pet wood	brown	0n0w	19d
5	a3.2 b3.5	2.5	0.4	3.1	pet wood	brown	15e5n	19e
6	a2.5 b3.2	2.2	0.8	4.0	limest	white	42e10s	19f
7	3.6	2.2	0.4	3.1	chert	white-grey	0w0n & 0w5n	19g
8	a2.2 b3.4	2.2	0.7	4.0	silic limest	white	0w25s	19h
9	2.5	1.5	0.5	1.3	chert	grey-white	5e0n	19i
10	a1.3 b3.3	1.9	0.4	1.1	chert	grey-white	5e15s	19j
11	a3.1 b4.3	2.5	0.8	6.2	chert	light-tan	15e15s	19k
12	a2.5 b4.3	a2.4 b2.5	0.7	3.2	chert	pink	42e5s	19l
13	3.4	2.3	0.9	6.6	chert	yellow-tan	15e10n	19m
14	3.4	2.2	0.7	5.5	chert	yellow-tan	0w0n	19n
15	a3.1 b ?	a2.0 b2.3	0.6	2.1	pet wood	dark-brown	5e97-123n	19o

TABLE IX (cont.)

Specimen	L (cm)	W (cm)	T (cm)	Wt (gr)	Stone	Colour	Prov.	Plate
16	a2.1 b3.0	2.3	0.5	2.9	chert	black	0w105s	19p
17	2.6	a1.8 b1.9	0.4	1.7	pet wood	brown	0w40s	19q
18	a2.5 b5.5	a3.0 b3.2	0.6	5.4	pet wood	dark-brown	0w15s	19r
19	a1.0 b ?	a2.2 b2.5	0.4	0.8	pet wood	brown	15e5n	19s
20	a2.5 b ?	a2.2 b2.5	0.6	2.6	pet wood	brown	0w40s	19t
21	a2.1 b ?	a2.2 b2.4	0.8	2.9	pet wood	tan-brown	15e40s	19u
22	a2.2 b2.5	2.2	0.4	2.4	chert	black	E Trnch	19v
$\overline{X}$	4.1	2.3	0.6	3.3				

Notes: a denotes a broken specimen.

b denotes an extrapolated measurement for a broken specimen.

c abbreviations used are:

Prov. = provenience
pet wood = petrified wood
Trnch = Trench

Material. The materials out of which projectile point preforms at the Harder site were made and the numbers of each are: 11 petrified wood, eight chert, and two silicified limestone. Petrified wood, with its tendency toward tabular fracture and internal planes of weakness, would seem a difficult material to work. Indeed, most of the material represented in this particular group of preforms is miserable for chip-

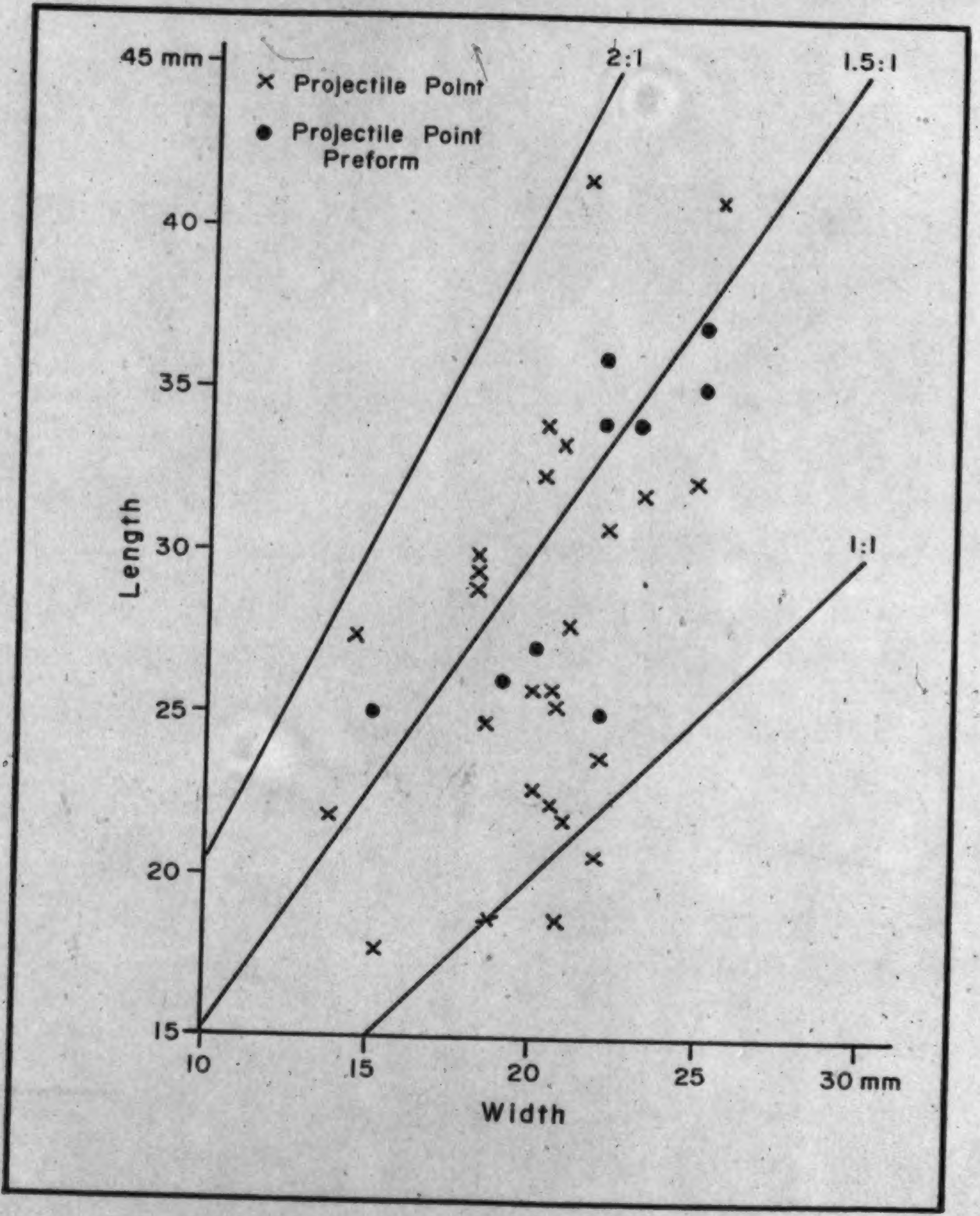


Fig. 15 Length plotted against width comparing projectile points and projectile point preforms.

ping purposes due either to interior faults, or to awkward shapes and thicknesses. One notable exception (Plate 19g), a white-grey piece broken in quarters, is made of a fine-grained fairly homogeneous chert. It equals the finest material used for projectile points.

Breakage. Out of the 22 specimens classified as preforms, two are complete, two are only partly roughed out but show no breakage, seven have the tip broken off, four have a corner missing due to a diagonal break from a lateral edge to the basal edge, one is broken into quarters - three of which I found and fitted back together - one is shattered both straight across from one lateral edge to the other and also diagonally from one lateral edge to the other (one piece recovered), four are broken straight across from one lateral edge to the other (two tips and two bases, each less than half of a whole piece, all non-matching), and one basal fragment is broken diagonally from one lateral edge near the base to the other near the tip.

Six of the seven breaks involving the tip are located very close to the tip, the seventh being approximately one-third the distance to the base. The six near-tip breaks are all in a diagonal plane; that is, the plane of the break intersects the planes of the two faces at angles noticeably less than the more than 90°. All other breaks are in a plane approximately perpendicular to the plane of the two faces (see Fig. 16). All six diagonal breaks are continuous with flake scars extending onto one of the faces of the preforms. In four instances the flake scar extends only a few millimeters from the break inward toward the centre of the preform. The cause of breakage is not known. On the two other specimens, however, the associated flake scar extends as an uninterrupted channel from the break downward across the face to the middle of the basal edge. On the basal edge of these two specimens is an indentation corresponding to the striking platform of a broad basal thinning flake. Thus it appears that the two latter tips were broken by basal thinning flake overshots. In fact, it seems possible that all preform breakage at the Harder site was connected to chipping problems and material used.

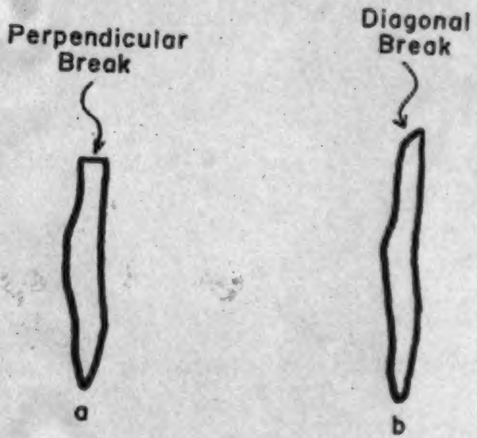


Fig. 16 - Longitudinal Cross-section of Projectile Point Preforms Showing Perpendicular and Diagonal Breaks

Chipping Technique. While projectile points give data about the latter part of the chipping process, projectile point preforms should fill in missing information about the early stages of projectile point manufacture. For the most part, they do. Close inspection has yielded information about (1) the form of the original piece of stone, (2) the type of flakes taken off in the reduction process, and (3) the probable sequence of chipping operations. These subjects are considered below.

Most of the preforms have been reduced to the stage that nearly all evidence for the original form of the parent material has been obliterated. Two specimens, Nos. 13 and 14, fortunately discarded due to chipping obstacles before knapping was much advanced, give an indication of what the original piece of rock probably looked like. In both cases the preform has been started on a thick flake struck off the original core at approximately 90° to the core platform. In one case the platform may well have been the cortical covering of the parent material; in the other, the platform has been prepared by previous flaking. Both original striking platforms are situated where juncture between lateral and basal edges of the preform should be. One specimen shows a slight reduction of the original platform due to removal of several flakes along the basal edge. Smaller platform remnants have been noted at the same location on some projectile points. Out of the 12 preforms with unbroken bases, seven have remnants of this platform.

Edges of the original flake have been obscured on all preforms, including the two mentioned above. In order to accommodate the preform, the edges must have expanded rapidly away from the platform. If an imaginary line is drawn across the face of the preform, perpendicular to the plane of the original striking platform, it intersects, the opposite lateral edge about mid-way to the tip. The tip then defines the minimum width of the original flake on one side of the imaginary line. Assuming the flake was symmetrical, the other edge must have been at least the same distance away from the line. Thus the reconstruction of a rapidly expanding flake blank seems reasonable.

The tip of the preform is also a useful reference point in an estimation of the length of a 'preform flake'. Using the same imaginary line, the minimum length of the preform flake is measured as that distance along the line between the striking platform and a second imaginary line which passes through the tip and intersects the first line at right angles. These measurements (see Fig. 17) have been tested on preforms with a platform remnant and it appears that minimum length of a preform flake (from proximal end to the distal end) was usually a little less than minimum width. The diagonal orientation of the preform within the original flake, then, was an economical method of obtaining a piece with length greater than width from a parent piece that had approximately the same length as width. Such a maneuver would be an important technique for stone workers confronted with sources of chipping stone that produced mainly small pebbles or else thin slabs of material. Brown petrified wood and tan and black cherts which dominate the Harder collection commonly occur in such forms.

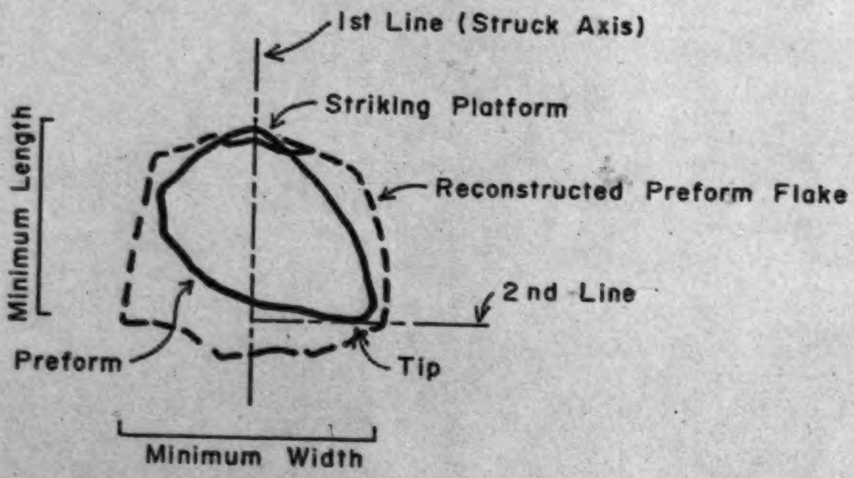

1st Line (Struck Axis)
Striking Platform
Reconstructed Preform Flake
Minimum Length
2 nd Line
Preform
Tip
Minimum Width

Fig. 17 - Preform Landmarks and Imaginary Lines Used in Measurement of Minimum Dimensions of Original Preform Flake

Since most preforms are completely blanketed with bifacial retouching scars, it is obvious that, due to reduction, the preform is thinner than the original flake. How thick was the original flake? One of the slightly worked preforms (no. 13) possesses an unaltered preform striking platform which supplies some of the information. Immediately below the striking platform the thickness of the original flake swells, due to the flake's bulb of percussion. The maximum thickness of this area is 0.9 cm. Below the bulb of percussion, a flake normally thins rapidly until the edge of the bulb is reached, thereafter thinning very gradually toward the distal end. Thinning flakes from the tip of the preform under consideration have removed the distal part of the preform flake up to and onto the bulb of percussion, so that the usual proximal to distal thinning of the flake cannot be seen. Chipping on the tip area has been taken part way on both lateral edges, revealing the finished thickness the preform should have had. The thickness of the worked area is slightly over 0.4 cm, so including the bulb of percussion, the finished thickness of this particular specimen would have been approximately 0.45 cm, one-half the maximum thickness of the original flake.

In summary, a typical preform flake had basic dimensions of about 3-4 cm. width, a length perhaps truncated to about 3-4 cm, and a maximum thickness through the bulb of percussion of about 1 cm. In planview it was probably nearly square; in cross-section somewhat wedge-shaped with the thick end nearest the striking platform. In looking over the chipped stone debitage for examples of such flakes, I found a few broken ones and a few somewhat smaller than the typical specimen. I also found scars on a couple of cores which resemble the reconstructed flake, but I did not find any specimens which could have answered the purpose of a preform. This absence is not unexpected since the Oxbow stone chippers probably had already used them.

A concluding point on the form of preform flakes concerns alternatives. The typical preform flake reconstructed above was probably used often, but not exclusively. The logical alternatives are (1) larger thicker flakes, which, with a little more reduction, could easily have been made into preforms, and (2) fortuitous flakes which needed only a little trimming to finish them. The first alternative would be a luxury for people in a 'stone poor' condition, which may have prevailed at the Harder site. On the other hand, there is no doubt that the Harder people used the second alternative more than once. Preform Specimens No. 5 and No. 9 show the original flake scar on most of the central area of both faces. Only the margins have been retouched, a feature which indicates the use of a fortuitously appropriate flake.

The flakes removed during the manufacture of a preform seem to have been of three types. The first type, known from only one specimen, preform No. 13, may be called large reduction flakes. This was a long broad flake used to remove the excess stone along the lateral edge opposite the original striking platform. It served, at the same time, to thin the stone by removing a layer off the face including the bulb of percussion. Probably only one or two such flakes were required for each preform. The important shaping of the lateral and basal edges and the final thinning of the central parts of the faces was done with a second type of flake. It was the same as the 'broad thinning flake' of the projectile point manufacturing process. The third type of flake, which was the same as the projectile point 'narrow finishing flake', was used at the end of the process to remove the small ridges left between broad thinning flakes. In cases involving a fortuitous flake, narrow finishing flake scars, closely spaced along the margins and extending on only a short distance onto the face, were often the only evidence of chipping.

Assuming that a knapper had a preform flake in hand, I propose the steps he would take in reducing that flake into a preform would follow a fairly regular sequence.

(1) Removal of excess stone beyond lateral edge opposite the striking platform using large reduction flake(s).

(2) Tip and lateral edges roughed out using broad thinning flakes. Lateral edges were worked from the tip toward the base, each side being kept about even with the other in progress toward the base.

(3) When the lateral edges had been roughed out, the basal thinning was started using broad thinning flakes. Because of the preform flake's bulb of percussion, the base started off a good deal thicker than the tip and consequently required removal of many more broad thinning flakes in order to bring it down to approximately the same thickness as the tip. During the course of basal thinning, the basal edge was transformed from an original convex curve to a straight edge, or, more frequently, to a concave curve. The depth of the concavity would be related to the number of flakes required for thinning and the size of their striking platforms.

(4) When the base had been adequately thinned there might still be a high remnant left at the centre of the face. An example of such a remnant appears on Specimen No. 15. Removal of this remnant was the second last step, and used broad thinning flakes. The remnant could have been removed by a flake(s) originating on either of the lateral edges, except that a flake with such an origin would have left a nick on the otherwise smooth edge. In order to avoid this possibility, a central high

spot, left over at the end of the roughing out process, was removed from the base. Since the basal edge was already concave due to the removal of many thinning flakes, a couple of additional thinning flakes would make the base only slightly more concave than it was before. It would not require any further alterations Hence, the final thinning flakes came from the basal edge.

(5) Ridges between broad thinning flakes were removed; and, coincidentally, the lateral and basal edge curvatures were smoothed using narrow finishing flakes. The preform was now finished. There was no edge abrasion on any of the Harder site preforms.

Distribution in the Site. The horizontal distribution of projectile point preforms and other chipped stone tools is shown in Fig. 13. Preforms were widely scattered throughout the site: two were associated with the materials in 0w105s; two were associated with the slight concentration of chipped stone tools in the four adjoining excavation units, 5w40s, 5w35s, 0w40s, and 0w35s; nine were in the long concentration of items extending over units 0w20s-10n; three were among a small group of tools and a mass of chipping debris in units 15e5-10n; and the remaining six were scattered singly. I cannot identify a pattern in this distribution.

The vertical distribution of preforms relative to sub-zones within the Oxbow component is shown in Table VIII. There is no record of the depth of two preforms recovered from earth shaved off the ditch profile, and one recovered from the East Trench. The percentage of preforms in each zone is reasonably close to that of projectile points.

Function. It is postulated that this group of small bifaces represents an intermediate stage in the manufacture of projectile points. The rough work had all been done (at the most advanced end of the spectrum) and the final form of the projectile point was complete, except for notches and less noticeable polishing touches. The idea that these are not tools, but are partly-made tools is the connotation of the class name, preform. I have not formally distinguished internal stages within this group; but the fact that some of the preforms are at the beginning of manufacture, while others are mid-way or at the end, is clearly implied.

For a long time I could not imagine what function these little bifaces might have served. My first thought had been that they were projectile point preforms - they had approximately the right dimensions, size, and shape - but I had dismissed this idea because the material was so much poorer than that used for projectile points. The reasoning was that preforms and projectile points must be made out of the same quality of material. This reasoning does, of course, hold true for those preforms that were good enough to be continued along the manufacturing process until they emerged as projectile points. But very few high quality preforms would have survived as preforms, since, in most cases, they would be continued to the projectile point stage. Those preforms most likely to be discarded were the low quality specimens not suitable for further chipping. Thus, in a sample of manufacturing debris, a bias toward low quality preforms is predictable, and the quality difference between Harder site preforms and projectile points is readily explained. It would be unusual to find good preforms left behind. What we should find are preforms that failed to make the grade, which is what appears to be the case at the Harder site.

Class 3. Perforators. (N=5) (see Plate 20a-e)

Form. Perforators are flakes that have been unifacially retouched on parts of two edges which join to make a tip. The angle between the edges of the tip is generally quite broad, ranging from about 35° to about 65° for Harder site specimens. The edges leading to the tip are approximately straight. Fig. 18 shows the form of a perforator and measurements of its basic dimensions.

Basic Dimensions. The basic dimensions are the maxima of length, width, thickness, and weight. Measurements of these dimensions together with the material, colour, and provenience of each specimen are recorded in Table X, together with the means of measurements.

Material. Perforators were made of silicified limestone, chert, and petrified wood. Due to the thinness of each flake, extensive stone chipping was not possible, so chipping characteristics were probably a minor factor in their selection. The pieces had to be fine-grained enough to allow the production of a smooth edge, and tough enough to hold a thin edge. Most of the fine-grained silicates have these qualities to some degree. Silicified limestone seems to be about intermediate in quality between fine-grained chert and faulted petrified wood.

Chipping Techniques. The types of flakes upon which perforators were made is easily determined because the striking platform and a large portion

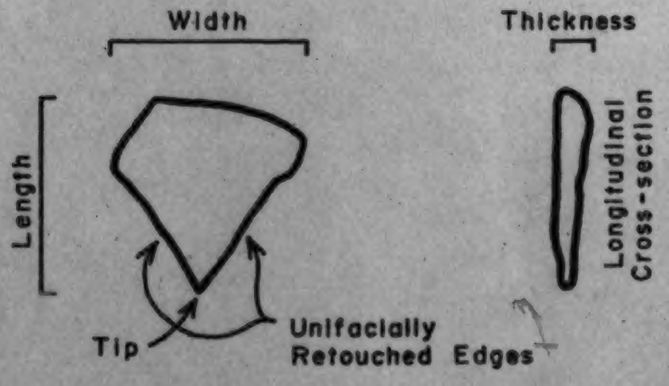


Fig. 18. - Elements and Measurements of Perforators

TABLE X

Basic Dimensions and Other Attributes of Perforators

Specimen	L (cm)	W (cm)	T (cm)	Wt (gr)	Stone	Colour	Prov.	Plate
1	2.8	1.6	0.5	1.2	silic limest	grey-blue	15e5s	20a
2	2.8	2.8	0.6	3.5	silic limest	tan-wht	Road	20b
3	4.8	2.4	0.4	5.0	silic limest	white-grey	5e5n	20c
4	2.4	1.4	0.3	0.5	chert	black	5e15s	20d
5	3.4	2.6	0.6	3.6	pet wood	brown & white	Road	20e
$\overline{X}$	3.2	2.2	0.5	2.8				

of the rest of the flake remains intact. Two were made on the distal ends of long narrow bifacial thinning flakes; one was made on the lateral edges of a small contracting decortication flake; and the other two were made on expanding flakes driven off a smooth platform core, using one lateral edge of the original flake with slight modification, and chipping one new edge transversely across the distal end. The simplicity of a perforator's technical requirements and the variety of ways in which they could be fulfilled meant that a wide number of choices were open in selecting the flake blank.

Once the flake blank had been selected, the knapper removed a series of tiny flakes from the ends of two converging edges to make the tip. These tiny flakes were only 1 mm wide, about 1.5 mm long, and less than 0.5 mm in thickness. It is difficult to see all the detail of the scars of these little flakes on the specimens made of silicified limestone, but the change in edge angle and the smoothness of the edge clearly shows where they are situated as a group. On the black chert specimen, however, each tiny flake can be clearly seen. Some of the flakes overlap one another, others stretch from one flake to the next, touching but not overlapping. It appears that on the right edge the sequence of flaking was from the shank downward toward the tip, while on the left edge the sequence was opposite, from the tip up the shank. It would have been very convenient for a right-handed knapper to hold the flake, distal end toward himself, and work the right edge shank toward tip, than turn the flake 180° and work the other side again toward himself but this time, because the flake had been turned, from the tip upward on the shank.

One supposes that it is possible that each of the flakes was removed one at a time. This practice would have called for very precise, time consuming workmanship. A faster and more likely method would be to pry all the flakes off one whole edge in one motion. One of the specimens, No. 3, was damaged by a shovel in shaving the ditch profile. The edge of the shovel ran along the right lateral edge of the perforator just below the striking platform to a point a little over one-half way down to the tip. The result was that a series of tiny flakes were removed from the edge for a distance of 2 cm. Scars and positioning closely resemble the situation on the tip edges of perforators. The shovel chipping was accidental, but it illustrates the single motion removal of a sequence of tiny flakes very well.

The tip edges were retouched dorsally in all cases except one, Specimen No. 5, on which the right edge was chipped dorsally while the left edge had a few crude chips on both dorsal and ventral surfaces. This specimen is unusual in that it had some bifacial chipping on the lateral edges near the striking platform and encroaching onto the striking platform. It looks as if a small biface was in the process of manufacture and then broke. A large piece of it was used for this perforator. One other piece, Specimen No. 2, shows signs of additional modification. The proximal end has been modified by steep obverse retouch to form an end scraper.

Distribution in the Site. One perforator was found in a controlled excavation, two in ditch profile screenings, and two were found on the surface of the road. The three pieces that can be located on the site planview for chipped stone tools (see Fig. 13) seem to be situated toward the edges of a large concentration of chipped stone items stretching from 0w15s to 0w10n. Vertical location is known for only one specimen collected from a controlled excavation unit. It was in the middle sub-zone of the Oxbow component.

Function. I named this class of objects perforators because I think they were used to puncture holes in soft materials. In the New World there has been a tendency to refer to similar objects as gravers, and less commonly, drill-like artifacts. A drill makes a round hole in a material by being twisted round and round into it, while a graver makes a long thin incision in a material by being pressed and pulled over the same surface several times. A perforator, on the other hand, makes a hole in something mainly by straight-ahead piercing pressure exerted on a pointed object, with perhaps a little twisting and pulling added to help the penetration of the point.

Lynott (1975) has recently published an excellent set of observations on the micro-wear he observed on similar tools whose exact use was known. He made two sets of tools and used one for drilling and the other for graving. Drilling was done holding the tool between the fingers and turning it clockwise by rotation of the wrist in the same manner used to turn a door knob. The drill was turned as far as possible to the right and then returned as far as possible to the left repeatedly. The drills were tried on three different types of material, wood, bone, and leather; but no significant differences in micro-wear pattern were noted. The micro-wear on all three materials was comprised of tiny flakes on the edges and polish on the tip and ridges. Tiny inverse flakes were removed from one or both ventral edges near the tip. These flakes occurred farther and farther away from the tip as the tool penetrated into the object material. The tip was usually undamaged, but frequently built up a heavy polish. A line of polish also appeared on the dorsal medial ridge of the thicker pieces.

The graving action was executed by holding the tool ventral face down at angles from 100° to 30° to the object being worked. The point of the tool was pushed and pulled along the same path in a back and forth manner. The same three materials were graved, and again no significant differences in wear pattern were observed among the three. Inverse (ventral) flaking was less common on tools used for graving and came straight off the tip, not off the sides as in the drilling action. A marked flattening of the tip occurred as a result of grinding and step fracturing of the dorsal surface of the tip. No polish appeared on the dorsal medial ridge as for drilling tools because that surface was never in contact with the object material; however, some polish did appear on the ventral surface.

I examined the Harder site specimens as closely as possible for similar signs of micro-wear with the following results. Specimen No. 1 has a flattened tip due to one or possibly two small flakes being broken off the dorsal surface (no inverse flakes, no polish); No. 2 has light polish on the tip, medium polish over the edge flake ridges on the right side, and light polish over the edge flake ridges on the left side (no inverse flakes, no tip damage, no dorsal ridge or ventral polish); No. 3 has a flattened tip due to removal of one flake from the dorsal surface, two inverse flakes on the right side, and a light to medium polish over the flake ridges of the left edge (no ventral or dorsal polish); No. 4 has a slight polish on the tip (no other micro-wear); and No. 5 has a slightly flattened tip due to several small step fractures, and also a light polish on the tip (no tiny inverse flakes and no dorsal or ventral polish).

These observations are not consistent with use as a drill or as a graver, but, instead, they suggest some aspects of both of these actions plus use as a perforator as indicated by the wear-polish over the edge flakes leading to the tip. Such polish was not noted by Lynott, and it would not be expected considering the actions he used. A perforating action could account for this additional wear pattern and the other micro-wear which resembles parts of Lynott's drilling wear and parts of his graving wear.

If the tool was held between the thumb and first finger so that one face was against the thumb and the other against the finger, with the tip of the tool protruding out beyond the end of the thumb, and if the tip was pressed hard into the object material with some twisting of the wrist to help penetration, a polish should develop on the tip, occasional inverse flakes might be removed, and sometimes the tip might break or flatten out due to the pressure exerted on it. These features have been observed on the Harder specimens. This action would accomplish the puncturing of a thin material. Then, to open a slit in the material, the action of the tool could simply be changed to an up and down sawing motion. This action should produce a polish over the flakes of one edge. If the worker tended to use one edge more than the other, then one edge should show more wear. This pattern is apparent on the Harder specimens. It is therefore concluded that the Harder specimens were perforators.

One wonders what other tools may have been used in conjunction with perforators as part of a work kit and what material was worked with these tools. At the Harder site there is no way of knowing since the perforators, rather than being isolated with a small group of tools, were mixed with a large concentration of material including a wide variety of tool types. Fortunately, such a tool kit has been discovered at another site. The charred remains of two small coiled willow baskets were found on the floor of a burned house structure in South Dakota (Butler 1975:53). The site is part of a Initial Middle Missouri fortified village of about 30 houses which was victimized by enemy raiders sometime between A.D. 1100 and 1250 (Lehner 1971:100). One of the baskets contained one bone spatula, one bone awl, one bone punch or flaker, eight utilized flakes, four snub-nosed scrapers, three unifacially retouched flakes, and one bifacially retouched flake together with a few pieces of shell, small pebbles, and 15 Curcurbita seeds. This basket is thought to contain a tool kit for the coarser work associated with skin preparation. The other basket, which is of primary interest here, contained four bone spatulas, one bone awl with a broad base and shaft, six bone awls with thin cross-sections and highly polished surfaces, two utilized flakes, one bifacially retouched flake, and two unifacially retouched flakes one of which is a perforator of exactly the same style found at the Harder site (Butler 1975: Fig. 2m). This basketful of tools is thought to have been associated with the other major aspect of skin working; the sewing and decorating of apparel.

With the possible exception of the bone spatulas, all of the tools found in the basket with the perforator at the Fay Tolton site in South Dakota can also be picked out of the large collection of tools associated with the perforators at the Harder site. The association of polished bone awls with perforators raises a question about overlapping functions. Why have two different tools for the same purpose? Possible answers are that holes were made with stone perforators and widened with bone awls, or perhaps bone awls served more in the line of needles and pins.

Class 4. Small End Scrapers. (n=44) (see Plates 20f-ee, 21a-r)

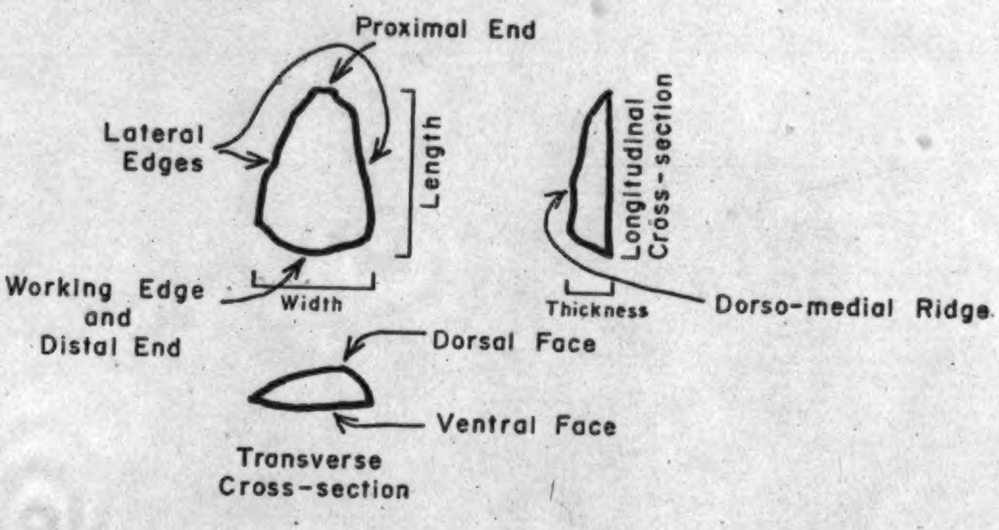

Proximal End
Lateral Edges
Length
Longitudinal Cross-section
Working Edge and Distal End
Width
Thickness
Dorso-medial Ridge
Dorsal Face
Ventral Face
Transverse Cross-section

Fig. 19 - Elements and Measurements of Small End Scrapers

Form. A small end scraper is a unifacial tool with steep retouching on a working edge that is roughly perpendicular to the longitudinal axis of the tool. In planview a small end scraper often resembles an isosceles triangle with lateral edges gently convex and a base that is also gently convex, but in contrast to the lateral edges, definitely a smooth curve. In longitudinal cross-section, the small end scraper is plano-(assymetrically) convex with the thickest part near the base and the thinnest part at the tip. In transverse cross-section most are plano-convex with a tendency toward slight assymmetry of the convex edge (apex usually right of centre) and occasional warping of the plano edge. Those that are not plano-convex are bi-plano.

Variations usually do not depart too far from the basic pattern. Occasionally the tip is flattened due to breakage or to the presence of the original striking platform. Sometimes the lateral edges are nearly parallel for most of their length but converge rapidly as they approach the end where the tip of the triangle should be. Only one specimen is radically different from the rest. It was made on a large slab of petrified wood that was approximately square in planview but has a convex projection on one edge (see Specimen No. 5, Plate 20j). The usual convex scraping edge has been made on the projection and the remaining edges have been left untouched.

Small end scrapers in the Harder site are unusually small in comparison with those from many other sites. For example, the average small end scraper at the Harder site is about 30 to 50 percent the size of the average small end scraper from the Connell Creek site, yet both sites belong to the Oxbow complex. There is a noticeable trend toward smallness in tools of all complexes in the Dunfermline Sand Hills compared to other areas of Saskatchewan, but the smallness of the Harder site specimens is extreme. Many are so small that it is hard to imagine how they could have been held and used. Yet the word 'small' in the class name does not refer to the size of the Harder specimens in comparison to specimens in the same class at other sites. It refers to the smallness of the class as a whole in comparison to a much larger class of end scrapers. This second class of end scrapers, distinguished partly by the large size of its members, is not represented at the Harder site, but it is part of the Oxbow tool kit at the Carruthers site only one-half mile south.

Basic Dimensions. The method of measuring the basic dimensions is shown in Fig. 19 and the measurements themselves, together with the attributes of material, colour, and provenience, and means are recorded in Table XI. It should be noted that, in calculating the ranges and means, extrapolated measurements were used in the place of broken measurements whenever reliable extrapolations were possible. Specimen No. 5 has been excluded from the calculations because its form and dimensions (those of a slab of core shatter) are radically different from the rest of the specimens.

Material. At the Harder site various kinds of fine-grained stone were used for end scrapers as follows: 50% chert, 23% chalcedone, 20% good quality petrified wood, and 7% silicified fossiliferous limestone. The absence of quartzite and low quality petrified wood is obvious. Such materials would not have been conducive to the finely controlled retouching required along the working edge. A few pieces are comprised of partly faulted or porous cortical material as well as fine-grained stone. In those instances the poor part of the stone is always located on the dorsal face in a position that would not interfere with retouching on the fine-grained working edge.

Breakage. Forty percent of the end scrapers in this assemblage are broken. Four lines of breakage are evident on these specimens: (1) straight across from one lateral edge to the other between the working edge and the proximal end, perpendicular to the longitudinal axis; (2) diagonally from one lateral edge near the proximal end to the other lateral edge near the working edge; (3) diagonally from one lateral edge to the central area of the working edge; (4) shatter resulting in more than one line of breakage (see Specimen No. 25, Plate 20ee). Thus it appears that the majority of the breaks involved removal of the working end. None of the breaks begins at the negative impression of a striking platform and so I assume that none of the breaks occurred as a

TABLE XI

Basic Dimensions and Other Attributes of Small End Scrapers

Specimen	L (cm)	W (cm)	T (cm)	Wt (gr)	Stone	Colour	Prov.	Plate
1	2.4	1.7	0.6	2.6	chert	black	0w10s	20f
2	2.3	1.8	0.6	2.4	chalced	brown & tan	55e10s	20g
3	1.3	1.7	0.4	1.0	silic limest	mauve	55e10s	20h
4	2.8	1.8	0.5	2.6	silic limest	grey	0w5s	20i
5	3.7	3.9	0.8	12.9	pet wood	banded brown	0w10s	20j
6	1.7	1.9	0.4	1.6	chalced	orange	55e10s	20k
7	1.7	1.9	0.5	1.5	chert	yellow & black	0w10s	20l
8	1.8	a1.6 b1.7	0.6	1.7	pet wood	brown	0w50s	20m
9	2.1	a1.5 b1.9	0.5	a2.0	chert	olive	E Trnch	20n
10	1.3	1.7	0.3	0.6	pet wood	reddish-brown	0w10s	20o
11	a1.2 b2.0	1.9	0.4	a1.1	chert	white	42e5n	20p
12	a1.7	a2.4	0.8	a3.1	pet wood	tan-brown	55e15s	20q
13	a2.3 b2.5	a2.0 b2.1	0.4	2.0	chert	grey-white	0w60s	20r
14	a1.7 b2.2	2.0	0.6	a2.2	chert	yellow-white	W Trnch	20s
15	1.4	1.6	0.6	1.3	chert	tan-grey	55e0n	20t
16	a1.6	a1.4	0.5	a1.2	chalced	white	0w10s	20u

TABLE XI (cont.)

Specimen	L (cm)	W (cm)	T (cm)	Wt (gr)	Stone	Colour	Prov.	Plate
17	1.7	1.7	0.2	0.8	pet wood	brown	road	20v
18	a1.2 b1.8	1.9	0.3	a0.9	chalced	brown	5e35s	20w
19	2.3	1.6	0.5	2.0	chert	yellow-tan	55e15s	20x
20	2.3	a1.5 b1.8	0.6	2.1	chert	dark tan	0w10n	20y
21	1.6	2.0	0.6	1.7	chert	dark olive	15e5n	20z
22	1.7	1.9	0.6	1.8	chert	grey-blue	55e15s	20aa
23	1.9	1.9	0.7	2.5	chert	lustrous brown	0w10s	20bb
24	2.3	1.2	0.4	1.0	chalced	white	0w5s	20cc
25	3.2	1.6	0.7	2.5	pet wood	brown	5w0n	20dd
26	2.0	1.6	0.4	1.6	pet wood	brown	road	20ee
27	1.1	1.4	0.3	0.5	chalced	brown	0w0n	21b
28	1.3	1.6	0.4	0.7	silic limest	white	0w15s	21a
29	1.7	1.7	0.5	1.3	chalced	brown	E Trnch	21c
30	2.3	2.0	0.7	3.1	chert	tan-orange	0w5s	21d
31	a1.1	a1.7	0.3	a0.9	pet wood	tan-banded	5w40s	21e
32	a1.2	a0.9	0.3	a0.3	chert	grey-blue	0w30s	21f
33	1.4	1.6	0.4	1.0	chert	yellow-brown	0w35s	21g

TABLE X1 (cont.)

Specimen	L (cm)	W (cm)	T (sm)	Wt (gr)	Stone	Colour	Prov.	Plate
34	a0.7 b1.8	1.4	0.4	0.5	chert	grey-red	0w0n	21h
35	1.2	1.5	0.5	0.6	chert	grey	0w15n	21l
36	12.	1.3	0.4	0.5	chalced	brown	0w55s	21j
37	a1.2	a1.3	0.5	a1.2	chert	grey-white	0w65s	21k
38	a1.7	a1.9	0.5	a1.4	chert	light-tan	0w5n	21l
39	a1.4	a1.2	a0.4	a0.6	chert	tan	0w15s	21m
40	a1.6	a2.0	a0.7	a1.6	chalced	brown	0w60s	21n
41	a1.3	a1.2	a0.5	a0.9	chert	light-tan	0w15s	210
42	1.9	a1.3	0.4	a1.2	chalced	yellow-banded	15e40n	21p
43	2.0	1.3	0.5	2.0	pet wood	yellow-tan	0w0n	21q
44	1.6	1.8	0.4	1.2	chert	black	0w35s	21r
$\overline{X}$	1.9	1.7	0.5	1.6				

Notes: a denotes a broken specimen.

b denotes an extrapolated measurement for a broken specimen.

c abbreviations used are:

Prov	=	provenience
chalced	=	chalcedony
silic limest	=	silicified limestone
pet wood	=	petrified wood
trnch	=	trench

result of the removal of a flake from an edge. Other possibilities are breaks due to impact heat, or to pressure applied to the tool.

Chipping Technique. Certain characteristics are shared by all the end scrapers. The proximal end is never the thickest part of the flake. In most cases the thickest point lies along a ridge just above the working edge. In some flat specimens the thickness is approximately the same throughout the whole central area. Secondly, the majority of end scrapers are made on rapidly expanding flakes, while the remaining few were apparently made on gently expanding, nearly parallel sided flakes. Flakes with these general characteristics could have been made in several ways, from several core and platform arrangements. Understanding of the possibilities that may have been utilized requires consideration of the striking platforms still present.

Fifteen end scrapers were retouched or broken so that they offered no information about the striking platform. An additional 10 specimens made on decortication flakes supplied only ambiguous information. Eight were primary decortication flakes; their dorsal faces were entirely original cortex except along the edges where retouching has exposed the inner material. Most have a tiny bulb of percussion showing which is the proximal end. None have a striking platform, but a few have slight crushing where the striking platform should be. The other two are secondary decortication flakes with a dorsomedial ridge, on one side of which is original cortex while on the other is a fracture surface. These, too, were crushed at the proximal end where the platform should be. This group accounts for over 50% of the specimens.

The balance is divided among three platform types. The first type will be referred to as a point platform (Fig. 20 and b). The zone of impact is a very tiny ridge in the same place as the ventral face. The bulb of percussion is corrugated by ridges and tiny valleys radiating out from the point of impact or else there is nearly no bulb of percussion. A few tiny shatter flake scars may extend from the point of impact onto the dorsal face. The longitudinal section is generally slightly concave ventrally and convex dorsally. This type appears to be the same as Binford and Quimby's (1963:297-98) Class II, Variety C, flakes removed from a bipolar core. Seven specimens have this type of platform.

The second type features a flat platform (Fig. 20 and d), lying in one plane (sometimes roughened), and approximately lenticular in plan-view. Platform widths vary from 0.5 cm to 1.1 cm, while the angle between the platform and the ventral face is generally between 100° and 110°.

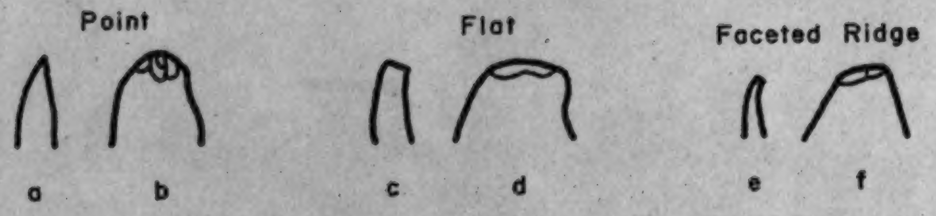


Fig. 20 - Longitudinal Cross-section and Ventral Face Views of the Striking Platforms on the Proximal Ends of Small End Scrapers. a & b, point platform; c & d, flat platform; e & f, faceted ridge platform.

The platform surface is a small area of cortex in all cases at the Harder site, and may be absolutely smooth or quite rough depending on the original texture of the cortex. The bulb of percussion below the platform may be broad, but usually is thin. Platform characteristics together with other specifics of flake form and size conform to a flake type named by Binford and Papworth (1963:84) 'expanding flakes removed incidental to the production of flake blanks on a block core'. At the Harder site, seven end scrapers were made on this type of flake.

The third type of platform will be referred to as a faceted ridge platform (Fig. 20 and f). The ridge is the juncture between dorsal and ventral faces of the flake. It is faceted on both sides with alternate bifacial flake scars. The faceted surface on the dorsal side is continuous with the dorsal face, but the faceted area on the ventral side of the ridge is no doubt the true striking platform, originally the edge of a bifacial tool and/or core. The angle between the ventral face and the small faceted platform on the ventral side of the ridge is in the order of 130°. Frison (1968:149) has noted that on bifacial trimming flakes the dulled edge of the tool is usually obvious. Dulling was evident along the ridges of two of five end scrapers with faceted ridge platforms.

It is of interest to note that most of the end scraper flake blanks may have originated as biproducts of chipping processes aimed at other goals. For example, a good number are decortication flakes, while others are the incidental result of platform trimming of a block core or of thinning and resharpening a dull biface. The only type which may have been produced for its own sake is the point platform type. Assuming a bipolar core reduction technique with phases of reduction including both preparation of the core and production of flake blanks, it is possible that even point platform flakes may have been incidental. The implication of this discussion is that the person desiring an end scraper had only to sort through old chipping debitage to find suitable flake blanks.

Once the flake blank had been selected, a row of flakes was removed from the distal end and corners until the working edge was moderately steep with a slight outward curve. At this point 20 of the scrapers were finished. On the other 24, unifacial retouching was continued on one or both of the lateral edges. In most cases when chipping was started on a lateral edge, it continued to the proximal end. As a rule, the lateral edge flakes extend from the ventral face to the point of maximum thickness on the dorsal surface. On thin flat scrapers edge flakes are very short. On scrapers with a high dorso-medial ridge, edge flakes extend to the highest points on the ridge. The probable purpose of lateral edge retouch was shaping and smoothing to facilitate holding or hafting.

Two scrapers were double-bitted. Specimen No. 6 has the normal distal end working edge but, in addition, has a second working edge inverted on the left lateral edge. Retouching on the right lateral edge has created a pseudo proximal end for the second working edge. Specimen No. 7, an equilateral triangle, is also double-bitted. The retouched edges on both the distal end and the right lateral edge are virtually identical since the cortical flake on which they are made has a dome-shaped dorsal face with the point of greatest thickness at the centre.

Judging from the very small size of the end scrapers, most have been through several cycles of wear and resharpening (cf. Frison 1968). In order to prove that most of the scrapers had been larger at earlier stages of use, I searched the debitage to find retouch flakes that would fit onto scrapers. Such a procedure, if successful, should also show what state of wear called for resharpening. Two matches resulted involving left lateral edge flakes on two scrapers. In both cases flake and scraper were in the same excavation unit.

On Specimen No. 25, one lateral edge had been retouched by tiny flakes leaving only one projection along an otherwise smooth edge. This projection became the striking platform of the matched flake, which, when removed, took a good deal more than the projection. The flake overshot the forso-medial ridge and removed about 65% of the crown of the scraper. Even in this condition, the scraper could have been repaired, had it remained in one piece. But it shattered into three more pieces and a spall popped off the central area of the ventral face. The shatter and spall suggest exposure to extreme heat. Specimen No. 2 has the appearance of a new scraper that was misshapen by the last flake. Under exposure to heat it also shattered and spalled becoming completely useless.

Specimen No. 30 is similar but less extreme. The matched flake originated at an edge projection situated at the point of juncture between the left lateral edge and the working edge. The striking platform was the tiny part of the ventral face within the projection. The axis of percussion followed an imaginary ridge between lateral edge and working edge up to and just past the dorso-medial ridge. The flake removed the shoulder of the scraper with minimal damage to the lateral face. The working face, however, was foreshortened on the left side by the thickness of the flake.

Specimen No. 30 has a working face to ventral face angle of 75° to 80° and an irregular working edge, and looks like a used scraper in the process of being refaced. The old working face is very steep and heavily laden with scalar retouch along the bottom, just above the working edge. A few small retouch flakes have been removed off the left side of the working edge to set up the projection (striking platform) for a flake that could sweep from one lateral edge to the other, removing the old working face and creating a new one at a shallower angle. Unfortunately, the flake failed to do this and the scarper was abandoned. In conclusion, Specimens 25 and 30 show that small end scrapers were both made new and repaired in the Harder site.

Distribution in the Site. Horizontal distribution of small end scrapers is shown in Fig. 13. These small tools, like projectile points, were scattered widely throughout the site. There are, however, two noticeable concentrations of end scrapers. In unit 0w10s and overlapping slightly into adjoining units was the densest concentration including 12 end scrapers. This location corresponds to a hearth-disposal area on a dwelling floor (see Fig. 29). Five end scrapers were found in a second concentration situated in unit 55e10s and spreading slightly into adjoining unit 55e15s. This location appears to be outside a dwelling floor.

Function. Shape, thickness, and working face angle create the impression that end scrapers were best suited for one kind of action. Out of the basic production processes including piercing, drilling, cutting, sawing, chopping, trimming, whittling, scraping, sharpening, digging and so on, end scrapers seem to be shaped for scraping and, with the curved working edge, for skin scraping in particular. Evidence of edge wear on Harder site specimens consists of variable amounts of scalar retouch on the working face, particularly the lower half, and, occasionally, a light but definite rounding and polish on the working edge. There is no comparable wear on any lateral edges except on the double-bitted scrapers.

Scalar retouch, often the most visible sign of use, is indicated by hinge fractures parallel to the working edge in a 1 to 2 mm wide zone across the bottom of the working face. The hinge fractures represent the distal ends of flakes originating on the working edge. On some specimens scalar flakes have undercut the working face. The more scalar retouch flakes removed, the more the working face was undercut, until stacked hinge lines eventually worked their way down to the working edge making it ineffective. The steeper the original working face was, the faster it would be dulled by scalar retouch. And so, within certain limits, an end scraper with a moderate edge angle would take longer to dull by scalar retouch than would a scraper with a steep angle. If use of a scraper continued after complete dulling by scalar retouch no more scalar retouch flakes could be removed, but further wear might be indicated, however, by striations and polish over (possibly obliterating) the stepped hinge fractures.

Limits on the way scalar retouch flakes could have been removed puts limits on the ways end scrapers could have been used. It is inferred that the working edge was put in contact with the object material with the proximal end raised clear so that there was an angle of 35° to 80° between the ventral face and the object surface. Then pressure was applied to the working edge downward into the object material and the scraper was pulled over the object surface, maintaining roughly the same orientation and moving along a line in the same plane as the longitudinal axis of the scraper. In relation to the scraper, the object material must have moved from the proximal to the distal end in order to remove scalar flakes off the working face. Thus, to the question 'Were end scrapers pulled or shoved?', the answer is that at the Harder site they were pulled.

It is not known whether end scarpers were hand-held or hafted. The scrapers are convenient to hold between the fingers, thumb against the ventral face, first and second fingers against the dorsal face, with the working edge protruding. Normal up and down movement of the wrist and pressure supplied by arm muscles could have accounted for the scraping action. But, assuming that these scrapers were used on such things as buffalo hides, I seriously doubt that such a tiny implement could be hand-held and do the job. Historically there were two types of scraping required for buffalo hides, of which I shall consider only the most common. Hides prepared with hair-on needed to be scraped inside for purposes of cleaning and thinning the hide. All prepared skins required this attention. To do this the skin was stretched in a frame or staked on the ground and the excess tissue and adhering flesh was hoed off in a very laborious chopping motion. Nothing less would do it because the inner skin, although pliable, clung to the hide tenaciously. Historic Indians used a beveled metapodial bone scraper for this job or else a hoe-like handle with a metal bit. It would be impossible to deliver a similar chopping action with a tiny hand-held scraper. Consequently, if end scrapers were used for hide scraping then they almost had to have been hafted. Furthermore, one suspects that pressure of scraper against hide may have had a part in producing scalar retouch and breakage.

Class 5. Thin Uniface Knives. (N=7) (see Plate 21s-ii)

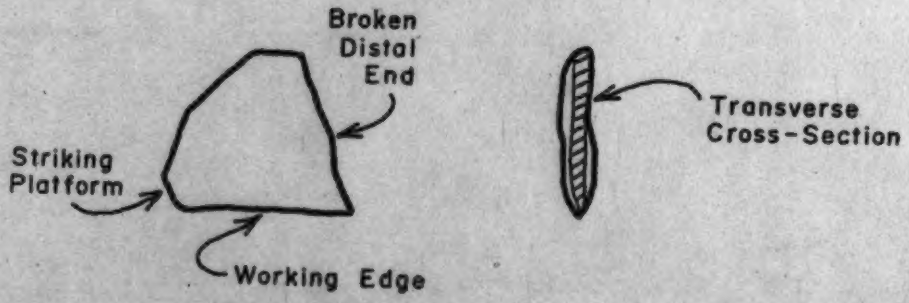


Fig. 21 - Elements of Thin Uniface Knife Form

Form. A thin uniface knife is a flake with one unifacially retouched edge, generally about 2 cm long. The working edge is a very sharp thin edge. In planview the working edge is usually straight, but is occasionally slightly concave or slightly convex. In longitudinal view the working edge is usually straight. The outlines formed by non-working edges (in planview) vary from rectangles to semi-circles to triangles to trapezoids to any sort of irregular variation of these. However, the non-working edges never encumber the working edge. Fig. 21 illustrates the basic elements of thin uniface knife form.

Basic Dimensions. The basic dimensions are maxima of length (measured parallel to the working edge), width (measured perpendicular to the working edge), thickness (measured perpendicular to the transverse cross-section), and weight. Measurements of these dimensions together with the material, colour, and provenience of each specimen and means of dimensions are recorded in Table XII.

Material. Thin uniface knives include the whole range of fine-grained stone at the Harder site and some of the better medium-grained material as well. In all cases, material of the utilized edge is homogeneous and unfaulted.

Breakage. Forty percent of the thin uniface knives were whole flakes; the balance were broken. All breaks intersected working edges mostly at angles between 70° and 90°. Out of the broken specimens, matching fragments were found for two, allowing reconstruction to the 'whole flake' condition. Both whole flakes are smooth-pebble cortical flakes (Specimens Nos. 11 and 14), and both appear to have been broken during the late stages of manufacture or during use, because each fragment possesses part of one continuous working edge indicating the edge was com-

TABLE XII

Basic Dimensions and Other Attributes of Thin Uniface Knives

Specimen	L (cm)	W (cm)	T (cm)	Wt (gr)	Stone	Colour	Prov.	Plate
1	1.6	2.0	0.2	0.9	chalced	brown	0w5s	21s
2	2.4	1.7	0.4	1.2	chalced	yellow-tan	0w30s	21t
3	2.7	2.4	0.4	2.5	quartzite	yellow-grey	E Trnch	21u
4	a1.7	2.6	0.4	a1.9	pet wood	tan	0w15n	21v
5	1.6	1.9	0.6	1.3	pet wood	brown	42e0s	21w
6	a1.6	1.7	0.3	0.7	pet wood	brown & white	55e5n	21x
7	a1.4	1.5	0.3	a0.4	pet wood	brown	55e0n	21y
8	1.7	2.0	0.3	0.8	pet wood	brown	15e10n	21z
9	2.1	2.4	0.3	1.0	pet wood	brown	0w5s	21aa
10	3.1	2.4	0.4	2.5	chert	black	0w35s	21bb
11	a3.2	2.6	0.4	4.5	quartzite	olive-brown	0w105s	21cc
12	2.2	1.8	0.4	1.9	chert	white	5w40s	21dd
13	3.5	2.1	0.5	3.2	chalced	brown	0w10s	21ee
14	2.3	2.4	0.5	3.3	chert	black	0w0n	21ff
15	2.3	1.9	0.4	1.3	chalced	white	0w40s	21gg
16	a1.1	1.6	0.3	a0.5	pet wood	brown	0w5s	21hh
17	2.0	2.0	0.4	1.3	pet wood	brown	0w15s	21ii

TABLE XII (cont.)

Specimen	L (cm)	W (cm)	T (cm)	Wt (gr)	Stone	Colour	Prov.	Plate
$\overline{X}$	2.3	2.1	0.4	1.9				

Note: a denotes a broken specimen.
b abbreviations used are:

Prov. = provenience
chalced = chalcedony
pet wood = petrified wood
trnch = trench

plete before the break. Considering that a large proportion of the chipped stone debitage consists of broken flakes, it is possible that some of the 'broken' specimens are whole tools made on broken flakes. Specimens with long working edges (2 cm or more) seem the most likely candidates for this category.

Chipping Techniques. As with small end scrapers, thin uniface knives were made on a variety of flakes including five bifacial thinning flakes, and one contracting flake trimmed from a block core. Three specimens were broken in such a fashion that the nature of the flake blank cannot be determined. All specimens are of fairly uniform thickness from one end to the other, except for the contracting trim flake which is noticeably thickest in the area of the striking platform. One smooth-pebble decortication flake had a ventral face working edge. All other thin uniface knives had dorsal face working edges.

The smooth-pebble decortication flake specimens are peculiar in that they were retouched on the distal end of the flake. The usual situation, seen in all other specimens, had the retouched working edge on one or the other of the lateral edges. Ten specimens, including all those which allowed a choice had the working edge on the left lateral edge (same as the west side when striking platform is north and dorsal face is up). The remaining lateral edge specimens were made on the right edge.

Flake scars show that the unifacial retouch flakes were 1.5 to 2.5 m long, 1 to 2 mm wide, and a fraction of 1 mm thick. My screens did not collect these small flakes, although I did collect a few by hand. The flake scars were either contiguous or overlapped along the worked edge in a fashion resembling the retouch or perforators. It is probable that here, too, flakes were removed by pressure and/or rasping. If a peeling method was used, then it is unlikely that broken specimens such as the reconstructed smooth-pebble cortical flakes were broken during manufacture. If they had been, the retouch should go up to the break and then stop. But the retouch does not stop at the break. Consequently it appears that for reconstructable specimens the break occurred during use, not manufacture.

Distribution in the Site. Six thin uniface knives were found among the general concentration of stone tools in the area of 0w15s to 0w5n, two were in units 55e0n and 55e5n associated with the small concentration of items to the south, three were among other tools in the block 5w40s to 0w35s, and the remaining six were scattered singly (see Fig. 13). A correlation may have existed between uses of polished bone 'awls' and thin uniface knives. Four knives were within one meter of a bone awl in 0w5s and two were within one meter of a bone awl in 55e0n. Vertical distribution (Table VIII) follows the trend established by other chipped stone tools.

Function. Initially, the function of thin uniface knives was postulated, on the basis of shape alone, to be best suited to whittling or to incising thin smooth lines. The tool will allow a good deal of (incising) pressure to be applied to the working edge, but only so long as the line of pressure was in the same plane as the ventral (or dorsal) face. Pressure applied outside that plane would have a tendency to snap the tool. For example, if one attempted to use the tool as an end scraper, pressure would have to be applied almost perpendicular to the ventral face plane; and it would snap along a line parallel to the working edge, assuming the whole working edge was in contact with the object material. Similarly, whittling, which calls for great pressure inside the ventral plane, but also outside it, would soon result in a snapped tool with the break parallel or perpendicular to the working edge depending on the pressure points. Moreover, in order to apply the necessary pressure to these small tools for the whittling action, the tools would have to have been hafted, for which there is no evidence. Therefore, on the basis of shape, this class of tools would appear to have functioned best as small incising knives.

The method of holding the knives may have been to squeeze them between the thumb and first finger. The pad near the tip of the thumb would be pressed against the dorsal (or ventral) face, while opposing pressure would be supplied to the other face by the lateral edge of the third phalanx of the first finger. The working edge would not be parallel to the long axis of the phalanx but would form a 30° to 40° angle with it, one end of the working edge on the finger near the tip, the other protruding out at about the first joint. Thus a thin projection with one sharpened edge would be exposed below the finger and thumb, which if pressed into something and then pulled along it would cut a thin smooth incision in the direction of the pull. Such an action would be useful for cutting and trimming taut leather, incising bark so it could be pulled off a shaft, splitting sinews on a cutting board and so on.

There is some evidence that thin uniface knives were used in this manner. Examination of the working edge under 30 power magnification reveals signs of wear usually at one end, sometimes at both ends of the working edge, but never in the middle. The wear is in the form of tiny reduction of the working edge (usually about 0.6 cm long), a very smooth edge in the reduced area in comparison (microscopically) with the tiny peaks and valleys in the adjoining central edge area, and a slight trace of crushing on the reduced edge while there is nothing but smooth flake scars in the middle of the edge. I could not detect any definite polish on either dorsal or ventral faces near the worn part of the edge. This wear is what might be expected if the tool's working edge had been pressed into the object material at an angle and then pulled to made an incision.

The breakage also conforms to this method of use. If, in being pressed down, the tool was leaned a bit too far to one side or the other, perhaps as a result of trying to make a curved instead of a straight line incision, the end of the working edge might snap off due to side pressure. The break would occur between the longitudinal axis of the phalanx and the end of the working edge, and would intersect the working edge about one-third the way down at approximately a right angle. A more common break might be due to the clamping pressure exerted by the thumb. With the thumb pressing in the middle of the tool and being opposed by equal pressure concentrated at the ends on the other side, the tools would have a tendency to snap in the middle. Furthermore, with these pressure points, the break would again intersect the working edge at approximately a right angle. Consequently, two predictable circumstances associated with the thumb and finger method of use could account for all the breakage observed on the Harder site specimens.

Similar thin uniface knives were found in both basket tool kits at the initial Middle Missouri Fay Tolton site (Butler 1975: Fig. 21w, x, and y). One knife was associated with fine skin work tools in Basket A, while three were found with the skin dressing and processing tools in Basket B. At the Harder site, all components of both kits (excepting the baskets) were found near thin uniface knives, and, therefore, by archaeological analogy with the Fay Tolton site, it seems likely that similar groupings of tools existed there.

Class 6. Biface Knives. (N=7) (see Plate 22a-f)

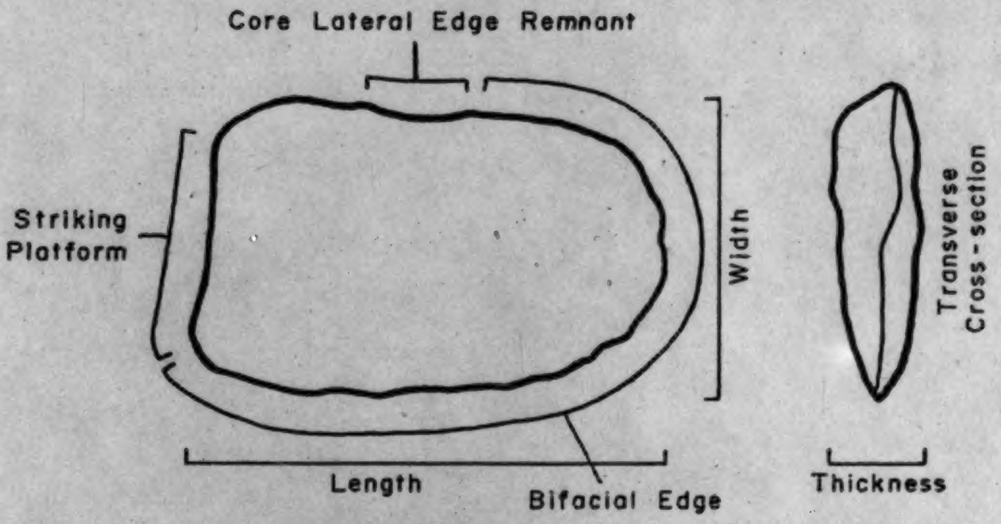

Core Lateral Edge Remnant
Striking Platform
Width
Transverse Cross-section
Length
Bifacial Edge
Thickness

Fig. 22 - Elements and Measurements of Biface Knives

Form. A biface knife is a large ovate flake with bifacial retouching along more that 80% of its perimeter. Some specimens are more elongated than others, with opposing long edges nearly parallel. Even in these cases, however, the bifacial edge is still slightly convex. Transverse cross-sections are generally irregularly biconvex, biplano, or plano-convex. Longitudinal cross-sections are either elongated biconvex or biplano. The original striking platform and part of the parent core's lateral edge often survive as unretouched remnants on the end and side, respectively. Essential elements of biface knife form are illustrated in Fig. 22.

Basic Dimensions. The basic dimensions are maxima of length, width, thickness (measured as shown in Fig. 22), and weight. Measurements of these dimensions together with material, colour, and provenience of each specimen and means are recorded in Table XIII.

Material. The biface knives were made of silicified limestone, petrified wood, and chert. The cilicified limestone and chert pieces have chipping characteristics of medium-grained silicates, while the petrified wood specimens, although fine-grained, are marred by internal tabular fault planes making controlled chipping more difficult than in unfaulted material. It appears that the finer-grained homogeneous material common to smaller tools was either too small in the raw state or too precious for large tools. Somewhat coarser or slightly faulted material served for biface knives at this site.

Breakage. The broken bifaces illustrate two types of breakage, namely, shattering and snapping. Specimen No. 1 broke diagonally from one lateral edge to the other. The break reveals two internal fault lines in the material. An additional fault was exposed near the striking platform by a deep wedge-shaped chip scar. The piece is shattered in the sense that it broke at least twice under normal chipping. Subsequently, an attempt was made to use the piece as a bipolar core with one corner of the original striking platform on the anvil and the point of intersection between diagonal break and lateral edge as the new platform. When one

TABLE XIII

Basic Dimensions and Other Attributes of Biface Knives

Specimen	L (cm)	W (cm)	T (cm)	Wt (gr)	Stone	Colour	Prov.	Plate
1	11.0	6.3	1.7	131.1	silic limest	white-tan	Road	22a
2	a4.7	4.6	1.5	a45.0	silic limest	mauve-white	Road	--
3	a2.4	a1.9	a1.4	a3.6	silic limest	pink-white	0w15s	22b
4	6.9	4.4	1.2	44.9	silic limest	tan-white	0w35s	22c
5	6.4	2.7	1.0	19.6	pet wood	brown	5w5n	22d
6	5.8	3.6	1.5	38.0	chert	yellow & black	42e0n	22e
7	a5.0	a3.1	0.6	a8.2	pet wood	brown	1535s	22f
$\overline{X}$	6.0	3.8	1.3	41.5				

Note: a denotes a broken specimen
b abbreviations used are:

Prov. = provenience
silic limest = silicified limestone
pet wood = petrified wood

twisted and rippled flake issued from this core, it must have been clear that nothing could be salvaged and the piece was abandoned.

Specimen No. 3 is a small triangular piece of shatter out of the edge of a biface knife. A segment of working edge forms the base of the triangle, and two converging lines of breakage form the sides.

Specimen No. 7, a large thin slab-flake of petrified wood, has a long diagonal break from one lateral edge to the other. The break has removed the distal end and most of the left edge of the tool. Part of the plane breakage, near the left lateral edge, is gently curved, intersecting the working edge at nearly a right angle. Along the incurved section the ventral edge of the break has a small projecting lip similar to that observed on some end scrapers. This appears to be of a snapping break.

Chipping Techniques. Biface knives seem to have been made exclusively on large thick flakes struck off large right angle platform cores. Most platforms are flake-scar surfaces; one platform appears to be a natual transverse break across the end of a slab of petrified wood. Most long axis of biface knives are coincident with the long axis of the flakes upon which they were made. On Specimen No. 6 the long axis of the emerging biface was 30° off the long axis of the flake because the flake had been broken transversely. In order to get maximum length, the diagonal from one corner of the striking platform to the opposite corner of the distal end was used as long axis of the biface. But this manoeuvre could not compensate for the other problems due to the break and the piece was abandoned unfinished.

Flake scares originating along the edges of the bifacial knives suggest that once the knapper had a suitable flake in hand, three more chipping operations were required to turn it into a functional biface. First came reduction and shaping of the best longest edge. Usually this process involved one whole lateral edge, the distal end, and parts of the other lateral edge. Chipping in this phase, as far as can be observed on this sample of specimens, was all unifacial, giving a rough shape to the working edge and at the same time thinning the dorsal face. Most flakes stopped a little short of the centre of the biface, often ending in hinge fractures and creating a low central plateau on the dorsal face. Wherever the edge was flat due to the presence of a remnant of striking platform, a remnant of core lateral edge, or a previous break or fault plane, an attempt was usually made to modify the flat segment by thinning and sharpening it with a series of flakes from both faces in the same manner as flakes are struck from a right angle core. This operation was not always successful because the hinge fractures sometimes piled up on each other (like scalar retouch) until no further chipping was possible. If the blunt section could not be obliterated, it had to be left alone.

A third operation centred the working edge, (from sideview perspective) smoothed it, and made the face-to-face angle of the working edge shallower, by alternate bifacial thinning. The flake scars left were about one-half the length of flakes removed in the first operation and like them often ended in hinge fractures. Occasionally, a line of hinge fractures parallel to the working edge and about 1 to 1.5 cm away from it can be seen to mark the inner boundary of the zone affected by the third chipping operation.

Distribution in the Site. Three biface knives were found on the periphery of the large concentration of stone tools in the area of 0w15s to 0w5n, one each was found in the smaller concentrations in the areas of 0w35s and 42e0n-5n (see Fig. 13), and two were discovered on the surface of the road. The record of vertical distribution shows one in the lowest sub-zone of the Oxbow component, three in the middle sub-zone, and one in the upper sub-zone. Large bifacial thinning flakes were scattered through the site.

Function. The long gently curved blade together with the chipped stone equivalent of a fine to medium saw-tooth working edge suggests these tools were suited to a fairly heavy handed cutting-sawing motion.

In a bison hunter's campsite such a tool would be useful in the dissection of cuts of beef brought into camp. It would also have served well as a butchering tool in the field where animals were killed. Each biface is large enough to be conveniently hand-held and sufficiently rough textured to assure a firm grip between thumb and fingers, even under greasy conditions. Other general functions such as chopping and digging were also considered; but such features as lightness, lack of heavy edge crushing or bruising in the case of chipping, and lateral position rather than end position of the working edge in the case of digging, combine to make other functions seem unlikely. Therefore, it was with a cutting-sawing motion in mind that I examined the working edges under low magnification for evidence of use.

The most extensive suggestion of use takes the form of numerous overlapping tiny flake scars with hinge fractures in a zone about 0.2 cm wide along the working edge. The tiny hinge fractures appear on both faces of an edge and are most numerous at those places where the edge is thickest. The reduction in the area of these hinge fractures is usually slight as the affected edge segment is at the same level or only slightly below the general curve of the working edge. Tiny flakes have a marked tendency to thin and sharpen the edge rather than dull it, a feature which makes it difficult to choose between the line of reasoning that says they are part of the manufacturing process and the line of reasoning that argues they are due to heavy pressure and abrasion of use. For the present the dilemma is unresolved.

Less intensive but more convincing signs of wear are slight smoothing of the working edge, particularly on higher points or ridges, and slight rounding or polish on ridges and peaks of both faces in a zone up to about 0.7 cm away from the edge. This wear appears on all parts of the working edge and is not noticeably concentrated in one segment more than another. As could have been predicted, wear did not appear on Specmen No. 6 which was unfinished. One might expect the edge smoothing to be more pronounced than it is, but in no place is it even as clear as the edge smoothing on the basal edges of many projectile points. Nevertheless, the fact that it is present lends support to the postulate that the tool use involved a cutting-sawing motion.

Class 7. Residual Retouched Items. (N=20) (see Plates 22g-i, 23a-q)

Form. Residual retouched items comprise the balance of the chipped stone tools. Each has some evidence of systematic (overlapping) retouch, although some pieces possess a good deal more edge retouch than others. It is possible that a few specimens belong in one of the previous classes. It is also possible that some represent new classes and some no class at all. I group the specimens together to emphasize the weakness of their present analytic position.

All residual retouched items were made on flakes. In planview, they are trapezoidal, triangular, or rectangular, or an irregular variation of these. In longitudinal cross-section the specimens are concave-convex plano-convex, bi-plano, or an irregular variation. Transversely, the cross-sections are plano-convex, bi-plano, or an irregular or assymetrical variation of these basic shapes. The retouched edge is usuallyslightly convex, but is occasionally concavo-convex or straight. Common variations of residual item form are illustrated in Fig. 23.

Basic Dimensions. The basic dimensions are maxima of length (measured parallel to the working edge or to the longest chord of the worked edge), width (measured perpendicular to the working edge or longest chord of the worked edge), thickness (maximum of thickness transverse cross-section), and weight. Measurements of these dimensions together with material, colour, and provenience of each specimen are recorded in Table XIV. Since there is a strong possibility that this is a heterogeneous group of specimens, the statistical means are omitted.

Material. The class includes both medium and fine-grained material, but, especially in the case of the latter, generally in faulted or misshapen form. Specimens of chert, silicified limestone, petrified wood, chalcedony, and quartzite comprise the sample.

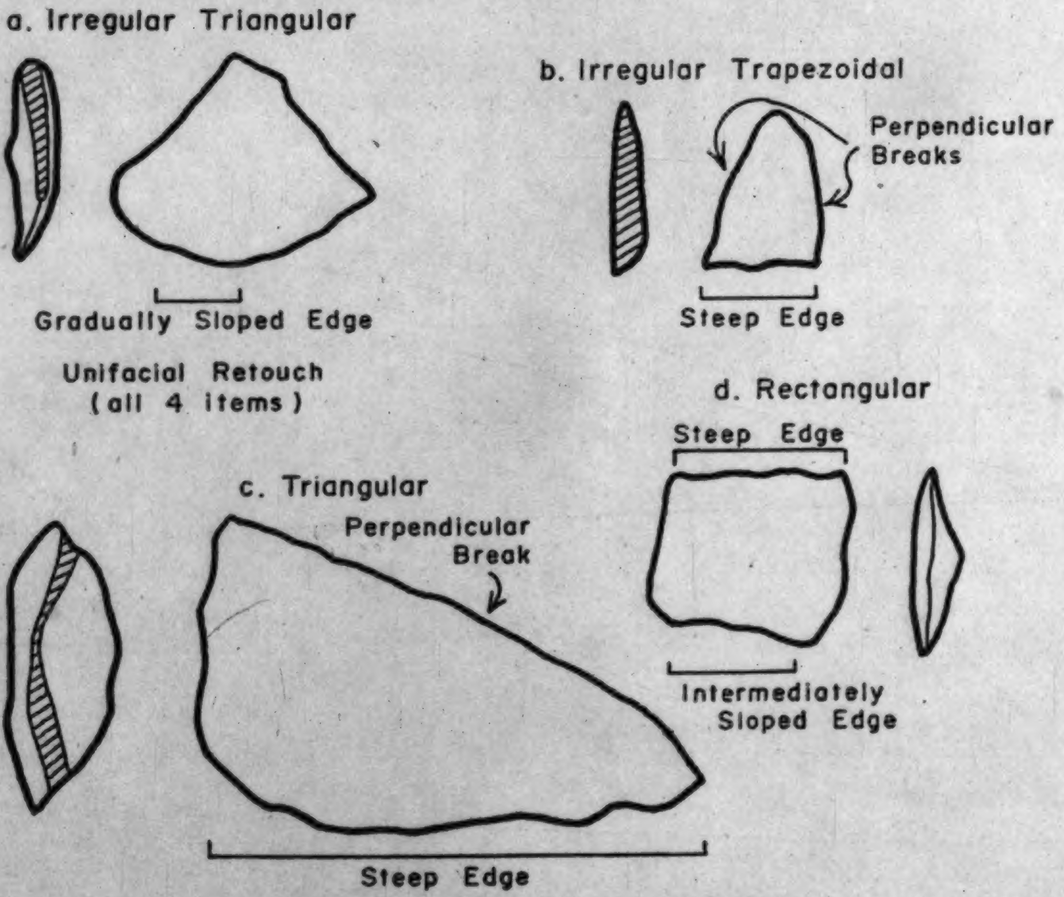

a. Irregular Triangular
Gradually Sloped Edge
Unifacial Retouch
(all 4 items)
b. Irregular Trapezoidal
Perpendicular Breaks
Steep Edge
c. Triangular
Perpendicular Break
Steep Edge
d. Rectangular
Steep Edge
Intermediately Sloped Edge

Fig. 23 - Variations in Form and Location of Retouched Edges of Residual Retouched Items, a-d.

TABLE XIV

Basic Dimensions and Other Attributes of Residual Retouched Items

Specimen	L (cm)	W (cm)	T (cm)	Wt (gr)	Stone	Colour	Prov.	Plate
1	5.2	3.7	0.8	27.5	chert	olive	0w25s	22g
2	4.7	4.1	1.0	20.5	silic limest	blue-grey	60e20s	22h
3	3.8	3.0	0.7	6.2	silic limest	white	0w15s	22i
4	3.8	2.4	0.7	5.5	chert	orange	0w10n	23a
5	3.4	1.2	0.6	3.0	pet wood	brown	ow45s	23b
6	3.2	2.3	0.7	4.0	chert	blue-tan	5w40s	23f
7	5.3	2.8	1.6	24.2	silic limest	blue	60e20s	23c
8	7.4	4.6	1.5	61.5	quartzite	red-tan	0w10s	23d
9	3.9	3.1	0.9	12.3	pet wood	brown	0w15s	23e
10	a1.5	2.2	0.8	a3.0	chert	tan	0w10s	23g
11	4.4	3.1	1.0	13.1	pet wood	brown	15e5n	23h
12	2.9	2.6	0.8	6.4	pet wood	dark-brown	43e0n	23i
13	3.9	2.6	0.7	7.2	chert	tan	E Trnch	23j
14	1.8	1.5	0.4	2.1	chert	olive-brown	55e0n	23k
15	a1.7	2.3	0.3	a2.5	chert	orange-tan	0w10s	23l
16	a1.1	1.5	0.3	a1.8	chert	tan-white	0w105s	23m
17	2.9	2.5	0.7	5.8	silic limest	white-grey	0w105s	23n

TABLE XIV (Cont.)

Specimen	L (cm)	W (cm)	T (cm)	Wt (gr)	Stone	Colour	Prov.	Plate
18	2.2	2.4	0.6	3.8	chalced	olive	5e0n	23o
19	2.2	1.8	0.4	3.1	chert	white	0w10n	23p
20	2.0	1.7	0.3	2.0	chert	grey & white	0w25s	23q

Note: a denotes a broken specimen

b abbreviations used are:

Prov. = provenience
silic limest = silicified limestone
pet wood = petrified wood
chalced = chalcedony
trnch = trench

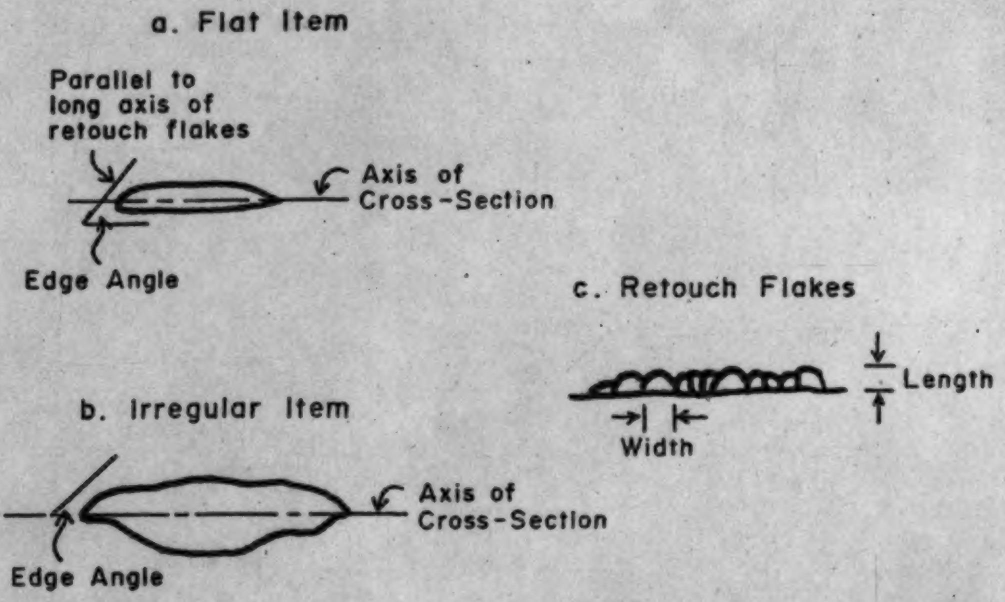
Chipping technique. The production method of the parent flake can be identified for about one-half of the specimens. Seven are expanding flakes from block cores with flat or facetted right-angle platforms, two are large bifacial thinning flakes, and two are bipolar flakes from ridge-point and point-area cores (Binford and Quimby 1963:291-93). Striking platforms have been broken off specimens in the other half of the class. Retouched edges are predominantly on the left lateral edges of flakes. Eleven worked edges occupy the left lateral position, while only two were on the right, and none was at either end position. Eight specimens were broken in such a fashion that orientation of the worked edge was impossible to determine. In all cases it appears that retouching occupies the best longest edge. In those cases, where two good edges exist on one specimen, both have been retouched.

All specimens but No. 9 were unifacially retouched, and in 17 of 20 cases retouch was on the dorsal face of the flake. Specimen No. 9, although bifacially retouched, retains the same edge cross-section as the unifacial items by having the dorsal face retouched steeply while the ventral retouch is extremely shallow. Thus all specimens have the edge contour typical of unifacially retouched items. From a side view, working edges are coincident with one of the two faces rather than being centred between them as is usual for bifacial edges.

Scars left by retouching are uniformly those of small flakes. Most were about 4 mm long and about 3 mm wide although both length and width varied from as little as 1 mm to as much as 7 mm. The steepness of retouch, measured as the edge angle (see Fig. 24), also constitutes a fairly broad field of variation with angles as shallow as 23° and as steep as 64°. The greatest number of specimens has edge angles of 40° to 50° and the arithmetic mean of all edge angle values is exactly 45°.

In a study of ten collections of Paleo-Indian chipped stone tools, Wilmsen (1970:70) discovered that edge angles tended to be clustered into three modes, namely, (1) an acute mode at 26° to 35°; (2) an intermediate mode at 46° to 55°; and (3) a steep mode at 66° to 75°. Elsewhere, Semenov (1964:20) has suggested that in stone whittling knives the blade-edge angle averages 35° to 40°. Thus, it seems the edge angles of Harder site residual retouched items do not cluster into the same value peaks as those found among other collections. An obvious explanation for this situation is that the class is a mixture rather than a homogeneous set of tools.

Distribution in the Site. Residual retouched items were widely scattered throughout the excavations, occurring both inside concentrations of other tools and also on the peripheries (for horizontal distribution see Fig. 13). Vertical distribution was similar to that of small end scrappers (see Table VIII).



a. Flat Item

b. Irregular Item

c. Retouch Flakes

Fig. 24. - Measurement of Edge Angles and Retouch Flake Dimensions on Residual Retouched Items.

Function. Residual retouched items may have been side scrapers, or false starts on one of the previous classes of tools, or finished but aberrant members of one of the previous classes of tools, or they may have been utilized flakes with retouching due to use. Yet another possibility is that they were a combination of all of these. The last seems to be the most likely possibility and a good initial working hypothesis. On the basis of steepness of edge angle and thickness of working edge, the majority are probably side scrapers (Nos. 1, 7-9, 11-16, 18). The wear evidence consists of light scalar retouch superimposed on the retouch flakes of most specimens and light smoothing or rounding of the working edge in a couple of cases. Perhaps as many as four specimens (Nos. 4, 17, 19, 20) were aberrant forms of the class, Thin Uniface Knives. Traces of wear, if present, are very difficult to see on these particular specimens. The balance of the class (Nos. 2,3,5,6,10) are probably either unfinished tools or utilized flakes.

BONE TOOLS, COARSE STONES, AND CARBONACEOUS-ASHY SOIL

Three material components directly associated with human activities at the Harder site remain for consideration. These are bone tools, coarse stones, and patches of carbonaceous-ashy soil. The three materials are not especially associated with one another in the site but are presented together here as a matter of organizational convenience. Bone tools, those pieces of bone showing signs of abrasion or scoring due to secondary modification and/or use, comprise a small part of the remains. The six bone specimens are described and classified in the first part of this chapter. Coarse stones, consisting of several varieties of large-grained rocks, many with very weak bonding between grains, make up a large part of the remains. Often simply assumed to be fire-cracked rocks and mentioned in passing, coarse stones deserve closer attention. Identification, mapping, and an attempt at functional analysis of coarse stones form the second part of the chapter. Carbonaceous-ashy refers to the colour and assumed source of a black-grey sandy soil matrix often found where tools, bones, and coarse stones were concentrated. Carbonaceous-ashy patches are mapped and briefly described in the third part to conclude the consideration of kinds of remains found at the site.

BONE TOOLS

Introduction

Even though bone was well preserved and in ample supply, only six pieces were positively identified as bone tools. Two additional bone fragments show the cut and chop marks seen occasionally on some of the bone debris. All the bone tools seem to have been broken and discarded, or at least partly discarded. One exception is a scraper that may be whole. Furthermore, the bone tools are all small. Large choppers, scrapers, and knives such as those commonly found in bison kills (cf. Kehoe 1967: plates 16, 19, 21, 22, 23; Frison 1970: figs. 17-20, 1974: figs. 1.14b, 1.16-19, 1.23-25) were not recognized at the Harder site. Since the bone debris was broken into much smaller pieces than in kill sites, odd pieces big enough to be large bone tools were quite noticeable. All larger pieces were examined for traces of wear, but nothing conclusive was found. Consequently, it is concluded that large bone tools either were never present, or if once present were taken away when the site was abandoned.

Bone tools were first identified by shape. Among a welter of angular chunks, slabs, and splinters of bones, tools with smooth conical points, thin rounded edges, or blunted and rounded ends were easily recognized. A few non-tools also possessed these characteristics, but were eliminated when under closer examination they failed to reveal signs of wear. The angular pieces were not ignored and long thin splinters with sharp ends, slabs and chunks with gently curved edges, and the broken ends of long bones and ribs were also examined, but with meagre results. There was one segment of long bone shaft with evidence of wear but no long splinter tools. Again, it must be pointed out that few pieces of bone had the potential for use as tools. Ends of long bones or ribs that still had a sufficient amount of shaft attached for use (as a chopper-skinning tool, for example) were rare. The odd piece that did have some potential showed no sign of use.

Tiny lines of incision and smoothing due to abrasion are the chief signs of manufacture and use detected on the bone tools. After initial segregation according to shape, bone tools were re-examined under 10 power and 20 power magnification. Short incisions (less than 2 mm long) and edge polish (surface lustre in the same area as edge rounding) were clear at

20 power. General surface abrasion resulting in overall smoothing and polish of certain regions often could be seen clearly with the naked eye. Most wear marks were located near or at one end of a tool. Details are given below.

Classification and Description

Following is a trial classification based on shapes of the tools and on working edges or surfaces. Due to the small sample, descriptive considerations predominate and functional issues, while briefly discussed, are left unresolved.

1. Split Bone with Long Polished Tip (N=2) (See Plate 26 a,b). Two specimens, each representing the broken tip of a long narrow tool, were found. Specimen No. 1 (Plate 26a) comprises the whole tip and part of the shank of a tool. It was broken in a perpendicular plane along an irregular edge-to-edge line intersecting the long axis at about 70°. In transverse cross-section the specimen is oval at the widest point, round at the tip. In side view, the longitudinal section looks like a long shallow inclined plane with the original outer surface of the bone down and horizontal, and the original inner surface uppermost and increasingly abraded toward the tip, creating a gradual incline of about 5°. The tip is situated on the ventral surface of the tool (original outer surface) and consequently is off centre from a side view perspective. From the top view it is centred, being approximately equidistant from each lateral edge. This arrangement shows that the tool maker maximized abrasion of the soft inner surface. The angle formed by the lateral edges near the tip is 16°. Basic dimensions of Specimen No. 1 are: length 3.4 cm, width 0.9 cm, and thickness 0.5 cm. Provenience was unit Ow5s.

Specimen No. 2 comprises part of the shank of the same kind of tool. The tip, other parts of the shank, and the adjoining handle section are broken off. The shape and orientation of original splinter were the same as Specimen No. 1, but with a slightly wider angle between edges (extrapolated 23°) and thinner maximum thickness (0.3 cm). No doubt the double breaks were related to thinness. The break nearest the tip (estimated 0.6 cm from tip) is in a sloping plane from the ventral edge backward away from the tip toward the dorsal surface. The second break a little farther along the shank is in the same plane, but has the additional feature of a shallow perpendicular break connecting the main breakage plane to the ventral surface and indicating a snapping type of breakage. Both breaks intersect the long axis of the tool along an irregular line at approximately 90° to the long axis. Provenience was unit 55e0n.

According to the sharp tip, dull tip, blunt tip, wear classes devised by Chomko (1975:29), Specimen No. 1 has a dull tip, and, of course, Specimen No. 2 has no tip at all. Wear by abrasion is distributed evenly on all sides of the tip, making it a short fat cone. Virtually the whole surface of both specimens has been subject to abrasion during manufacture. Specimen No. 1 has a bright lustre over its whole surface, while Specimen No. 2 has a dull lustre restricted to certain parts of the ventral face and sides. As Chomko has noted (1975:29), lustre may not be a good indication of use since other factors such as chemical alteration or weathering can lead to a similar result. A group of light short (3.5 mm) striations running parallel to each other diagonally down one side of Specimen No. 1 may be traces of a fine-grained abrasive used in the last stages of manufacture. The striations are situated in the middle of the side extending up to but not onto the rounding of the edges. Similar striations were not observed on Specimen No. 2, possibly due to obliteration.

The chief signs of use are short (1.5 mm), relatively deep incisions scattered and randomly oriented over all surfaces but especially on the two sides and ventral surface. The same type of incisions also appeared in small tight clusters usually organized into one main orientation per cluster. In one case all clusters on the ventral face (Specimen No. 2) line up into one diagonal pattern. Clusters of incisions on rounded edges predominate; and are generally diagonally oriented in a spiral around the long axis of the tool, indicating the screwing motion expected of an awl. The few clusters on more interior parts of a surface, especially on the ventral surface of Specimen No. 1, show orientations parallel to, diagonal to, and perpendicular to the long axis in one cluster; but the total number of incisions per cluster is less than in edge located clusters. Multi-oriented incisions may indicate occasional secondary use for pressing on a sharp pointed object in somewhat the same fashion as one would use a thimble. Such functional speculations require additional testing against a larger sample of tools.

2. Utilized Antler Tine (N=1) (See Plate 26 c) Three matching fragments comprising most of the distal end of an antler tine were found in unit 0w10s. The length of the reconstructed piece is 7.8 cm and maximum diameter is about 2.1 cm. Most of the surface exhibits an apparently natural polish. The tip itself bears no sign of use. A cluster of tiny incisions, roughly circular and 2 mm in diameter, occupies a position 5 mm from the tip. From there to the farthest break, clusters of incisions in several configurations and orientations can be seen on all sides of the specimen. In half a dozen places incisions are so numerous and closely packed as to have formed shallow pits. Elsewhere there are as few as three to five tiny incisions per cluster. The great majority of incisions are 2 mm or less in length. In general, they are oriented across the tine

perpendicular to the long axis and at diagonals up to 30° off perpendicular. Repeated pressing on a sharply ridged or pointed object seems to be the kind of use likely to have produced this type of wear.

3. Spatulate Bone Segment (N=1) (See Plate 26 d) A thin slab of bone, possibly part of one side of a split rib, has a thin rounded edge on two sides continuous with the blunt-point end. The other end bears a diagonal break, suggesting that the handle section has snapped off. Basic dimensions are: length 6.6 cm, width 2.2 cm, thickness 0.4 cm, and provenience unit 0w15s. Rounding of the edge appears due to both incision and abrasion. Edge incisions are very short (less than 2 mm) and relatively deep and are perpendicular to the long axis of the edge. Incisions tend to be clustered into small concavities along the edge, but the clusters are fairly evenly distributed along both sides and on the blunt-point end. Abrasion is also evenly distributed along the edge, in some places overlying and slightly obliterating previous incisions, and in other places underlying and emphasising newer incisions. Most of the incisions are centred on the ridge or apex of the edge, while those off-centre are about equally divided between clusters extending from the ridge onto the ventral face and clusters extending from the ridge onto the dorsal face.

Both faces also bear signs of abrasion and tiny incisions. The ventral (outer bone) face has three clusters of tiny incisions centred between the points where the sides begin bending to the blunt-point end. Generally, incisions transect the long axis of the tool at angles near 90°. Pairs and single incisions are scattered in the central part of the tool. Toward the broken end a pattern of four long incisions (up to 7 mm), about the same depth and a little wider than the tiny incisions, extends from one side toward the other on a diagonal that intersects the long axis at about 60°. The texture of the ventral face is rougher than the usual smooth surface of a bone shaft, a roughness not accounted for by the incisions observed, and apparently not due to muscle attachments. The roughness may be due to uneven chemical erosion or to earlier clusters of incisions obscured by abrasion. There is a narrow zone of surface lustre near the diagonal break.

The dorsal (inner bone) face is similar to the ventral face except that tiny incisions are more numerous and more spread out. And instead of being clustered into circular patches, incisions tend to be grouped into long zones like ties along a railroad track. The longest section, some 2 cm in length, includes approximately 25 separate incisions. It is sometimes difficult to determine where a group of incisions ends. The incisions are mainly between the base of the pointed end and the beginning of the constricted zone that is truncated at the handle end of the tool by a diagonal break. As with most other incisions, the orientation is approximately perpendicular to the long axis of the tool. Longer striations such as those on the ventral face were not seen on the dorsal face. Texture of the dorsal face is about as rough as the ventral face, but the surface, being the inner surface of the bone, is softer. Abrasion seems to have rounded the tops of high points all over the dorsal surface, but there is no surface lustre.

Split shaft spatulate tools are not uncommon in Northern Plains sites. Indeed, similar tools have also been found in Old World paleolithic sites (for example, Mousterian Kiik-Koba cave sites and Upper Paleolithic Aveevo and Kostenki I sites, Semenov 1964: figs. 92, 93). Yet, there remains some uncertainty about what function(s) were served by these distinctive tools. Speaking about the frequent occurrence of such tools in Middle Missouri Tradition sites, Lehmer (1971:88-9) has considered possible uses as "quill flatteners", or as pottery modelling tools, and has noted the association between these tools and female skeletons in graves, but in the end he remains uncertain about the function actually served. At the Boarding School Bison Drive site, Kehoe (1967:59,62) found a variety of spatulate bone flaking tools. Blackfoot informants suggested uses for the spatulas as marrow extracting tools, paint grinders, and paint brushes. In addition, Kehoe (1967:62) suggested skinning or butchering functions for some of the tools and a stone chipping function for others that were 'scored and ringed all around by transverse cuts'. Semenov's detailed observations on similar tools from Old World sites led him to conclude that specimens with 'slight dents hardly detectable to the naked eye' and with 'broad grooves one on top of the other' were retouchers used for delicate trimming of edges of flint cutting tools; and that split ribs which were flat, rounded on one end, usually broken at the other end, and with the soft inner surface heavily ground down were used as skin burnishers. The wear marks on the Harder specimen, thus, are partly like those of a retoucher and partly like those of a burnisher. In addition, with the considerable wear on the edges, Kehoe's skinning knife function cannot be dismissed.

4. Polished Bone Segment with incisions (N=1) (See Plate 26 e) The end of a polished, incised tool made from an elongated segment of long bone diaphysis was found in unit 0w20s. One side is straight and vertical to the end. The other side is parallel and vertical for a short distance, then curved and tilted inward as it joins the first side, creating a curved bevelled end. The line of breakage at the opposite end is in a vertical plane perpendicular to the long axis of the tool. Basic dimensions are, length 4.0 cm, width 1.9 cm, and thickness 0.9 cm. The whole surface of the tool excepting the broken area is polished, and much of it is lustrous. Yet, surface texture is uneven due to numerous single, double, and multiple incisions. A few shallow grooves are 8 mm in length, but the majority of

incisions are less than 3 mm in length. Most clustered incisions are on edges and sides. One particularly dense cluster is on the forward edge of the tip about midway between two sides. About 2 mm farther toward the tip on the same edge is another cluster with an older set of incisions perpendicular to the long axis of the edge. The two clusters create two small concavities in the otherwise smoothly curved end. Polish suggests a burnishing function, while the thickness combined with prominent edge-located clusters of tiny incisions suggests use as a chipped stone retouching tool.

5. Long Bone Segment End Scraper or Chopper (N=1) (See Plate 26f) A large mid-segment of a heavy bone with incisions and polish on the forward edge of one end was found in unit 0w5s. Basic dimensions are: length 10.4 cm, width 3.9 cm, and thickness 1.8 cm. The piece may be a whole tool, in which case its shape and working edge would be consistent with use as a scraper. If not a whole tool, then it might have been the tip of a long bone chopper. The source of bone was the posterior mid-section of a right tibia. Orientation is working end toward the centre and other end toward the distal end of the bone, an orientation which is consistent with the distal-handled tibia choppers described by Frison (1970:27-30). Frison (1970:30) also mentions discovery of tibia 'central portions with fortuitously formed edges bearing evidence of a deliberate shaping by light grinding and subsequent wear marks'. This description sounds very much like the object from the Harder site. Elsewhere, in an excellent set of observations and inferences, Frison (1974:52-4) has noted the presence of mid-segments of tibiae driven into the cancellous tissue of other bone such as the humerus, femur and thoracic vertebra. These tibia segments would appear to be ends of tibia choppers embedded and broken off in an attempt to fracture other bones.

In detail, the wear evidence on the Harder specimen consists of the following: the forward working edge is very steep, almost vertical to a height of 2 - 3 mm initially, but thereafter, following the plane of fracture, it is gently sloped onto the dorsal (inner bone) face. The vertical part of the edge bears the only signs of wear, namely dark polish and numerous tiny incisions transecting the long axis of the edge, particularly along the juncture between the vertical and gently sloping parts; wear is continuously present from the apex of the tip on one side of the tool up to a fracture scar on the other side; careful examination of the tip revealed little damage due to use; no flakes have been detached, although a splinter possibly due to use impact has come off the near side edge; at most there is only slight tip crushing, mainly on the near-side edge, coupled with light polish on the other side.

Lack of damage to the tip does not seem to fit with the idea that the object was part of a tibia chopper. The specimens illustrated by Frison all have at least one or two large flake scars eminating from the tip in addition to polish along the chopping edge. This specimen has minimal evidence for impact damage about the tip. On the other hand, if the piece were held thumb against the ventral face parallel to the long axis and with first finger curled over the edge onto the dorsal face, it would make a good right-hand scraper. Unfortunately, since the best evidence for use, namely, wear on the edge, could be due either to chopping or scraping, the exact function of the tool remains unresolved.

6. Bone Segments with Cut and Chop Marks (See Plate 26 g, h) The smashing of bones is well represented by bone debris. Two other aspects of butchering and dismemberment, namely, cutting and chopping, also left traces on some pieces of bone, an example of each being shown in Plate 26. The first specimen (g) is a segment of split rib with a series of parallel

diagonal incisions up to 4 mm in length quite prominent on the outer surface of one edge. The incisions are deep near the edge of the item and shallow toward the interior, indicating that the edge rather than the dorsal surface received the brunt of each blow. The same conclusion follows from the jagged appearance of the edge. A series of heavy pressure cuts or short blows seems to be indicated by the incisions. The second specimen (h) has a deep notch in one side due to a single heavy-handed chop at approximately the same angle as the incisions on the first specimen. In this instance the bone segment is part of an area of muscle attachment toward the end of a long bone shaft.

Distribution in the Site

The horizontal location of bone tools is plotted on Fig. 13 together with the chipped stone tools. Five bone tools are part of the dense concentration of materials in the area exposed by excavation units 0w0n to 0w20s, while the sixth is part of another concentration across the road in unit 55e0n. Vertical locations were generally the same as for stone tools, with two near the top of the component, three in the middle, and one at the bottom.

COARSE STONES

Introduction

Pieces of coarse-grained rocks were found scattered throughout excavations, as well as on the road and in the ditches. After broken bones, this was the most voluminous and weighty material, some 29.9 kg being recovered from controlled excavations alone. Pieces of coarse rock are easily separated from pieces of chipped stone on the basis of rough texture of fractured surfaces. Chipped stone is exceedingly fine-grained, in fact, so fine that one particle often cannot be differentiated from its neighbour even under high magnification. Such rocks allow fractures to pass through particles, while coarse rocks fracture between or around particles. Coarse stone particles, either pressed together or cemented together, are large enough to be seen under low magnification (10x) or with the naked eye. In the Harder site coarse particles range from the size of very fine sand grains (less than 0.5 mm) to the size of coarse sand (5 mm). Since the particles are not split by cleavage, the larger the grain size the rougher the texture of the fracture surface. Furthermore, fractures lack the glassy lustre so often seen on chipped stone. (See Plate 27 for a sample of coarse stone from unit Ow5s).

It is important to note that coarse stones are not readily available in the immediate Harder site locale. Unless taken from other occupation sites nearby, all stones had to be carried to the Harder site from glacial boulder deposits at least 9 km distant. It is also interesting that the coarse stones show a high degree of cracking and breakage. Although many bear part of the smooth cobble cortex, suggesting they probably arrived in the site whole, none are now whole; in fact only a few pieces are as large as half original size, while the vast majority are much smaller. Considering the fact that stones are not abundant locally, the high degree of breakage may reflect prehistoric frugality exercised by removing whole stones and leaving only broken ones. Breakage is also a reflection of use, but before coming to that question, the basic characteristics of coarse stones, namely materials and distribution, must be described.

Raw Materials

The main types of coarse rocks at the Harder site are (1) granites, approximately 45% by volume, (2) sandstones, approximately 35% by volume, (3) gneisses, approximately 15%, and (4) diabases, 5%. If the rocks were rearranged by grain size, coarsest to finest, the order would remain the same with granites at the coarse end, sandstones and gneisses in the middle, and diabases at the fine end of the spectrum. Such rocks, derived from bedrock in northwestern Saskatchewan (eg. Athabasca Sandstone) and in northeastern Saskatchewan (eg. Precambrian Shield granites, gneisses and diabases), are commonly found as erratic boulders in the glacial drift covering southern Saskatchewan. The Battleford Formation, the last glacial till deposited, is an especially boulder-rich formation. Wherever Battleford till is exposed and eroded in the Saskatoon region, a phenomenon known as boulder lag or boulder-covered surface appears (Christiansen 1970:15). A small concentration of surficial boulders with a very thin soil covering can be found 9 km east-north-east of the Harder site. A much larger area of boulder lag occurs some 21 km northeast. Thus, Harder site occupants had to travel at least 9 km to collect large quantities of coarse stones.

Distribution in the Site

Large pieces of coarse stone (greater than 5 cm in dia.) and medium pieces (2 - 5 cm in dia.) are plotted in Fig. 25. Small pieces were not plotted individually, but their distribution did conform closely to that of the larger pieces. Coarse stones were found throughout excavations, being noticeably concentrated in three small patches and two larger areas. The three small patches were in units 55e10s, 55e15n, and 0w40s. One of the two larger concentrations received 3 m^2 exposure in unit 0w105s. The

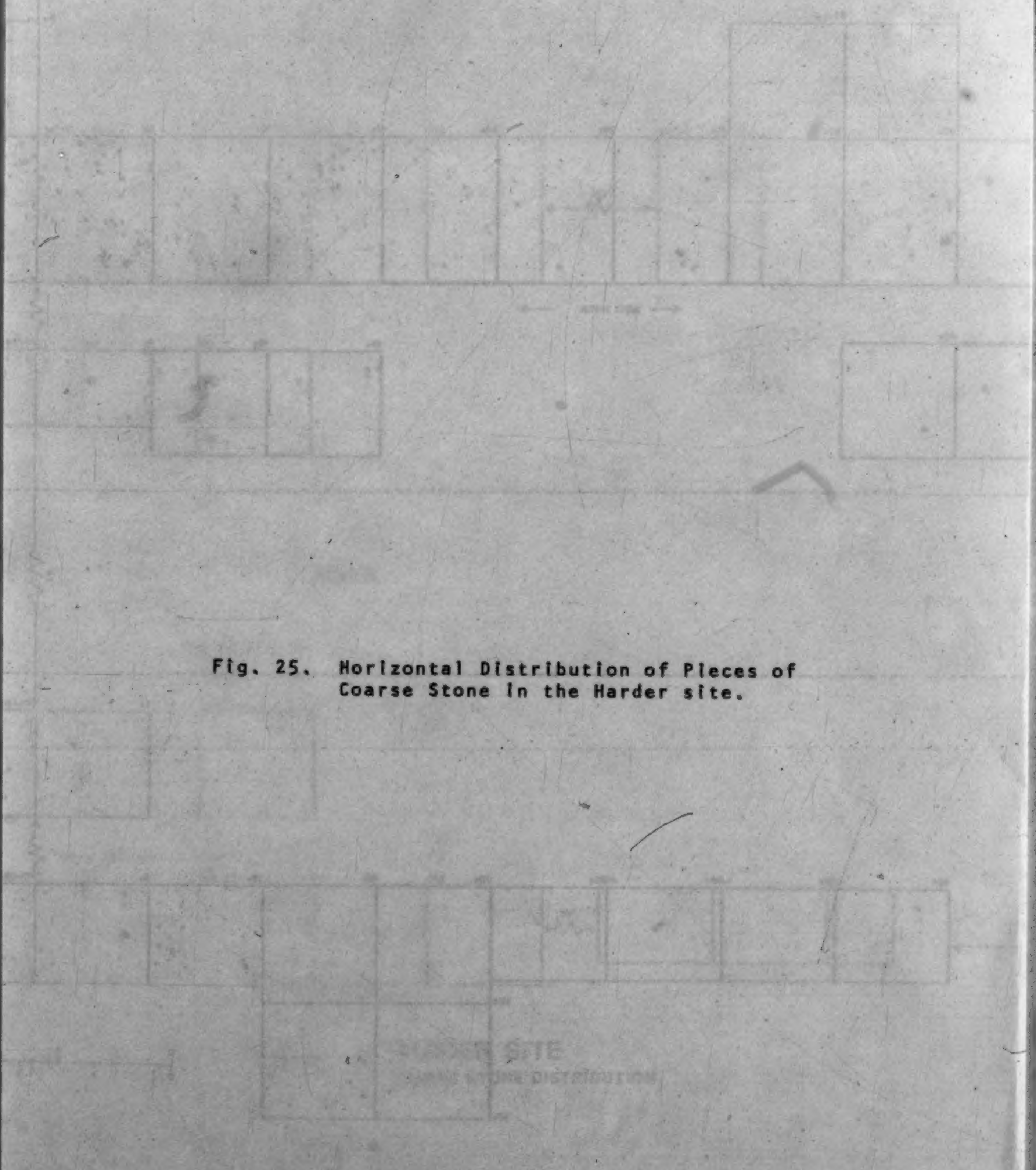
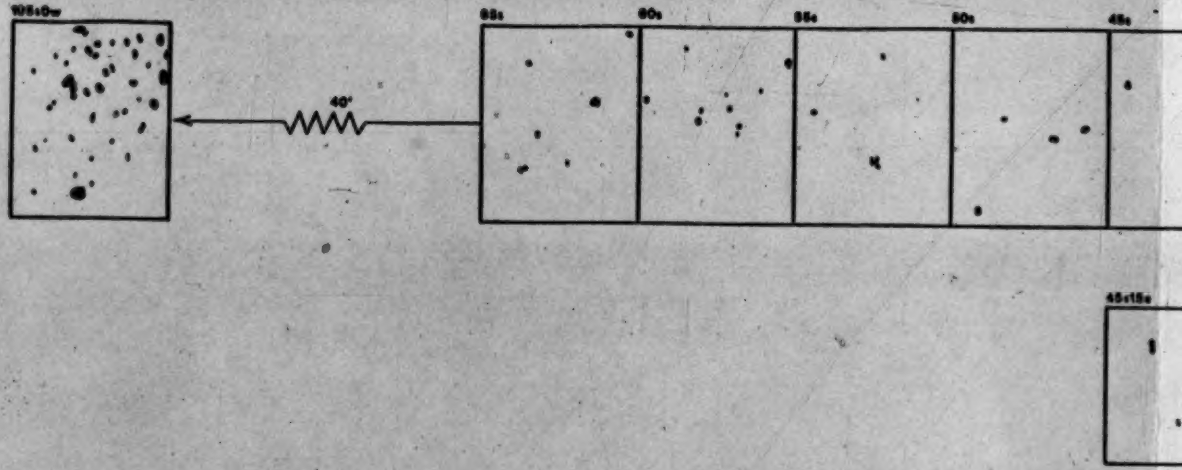

HARDER SITE
COARSE STONE DISTRIBUTION

Fig. 25. Horizontal Distribution of Pieces of Coarse Stone in the Harder site.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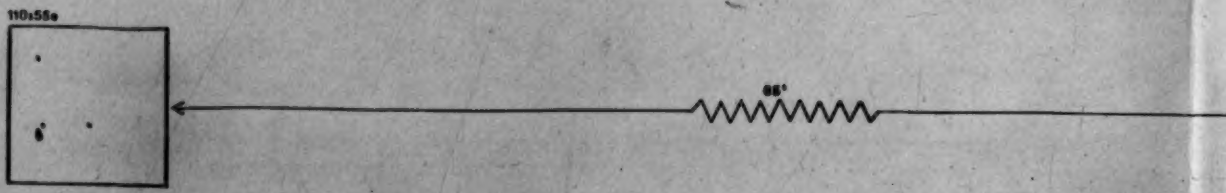
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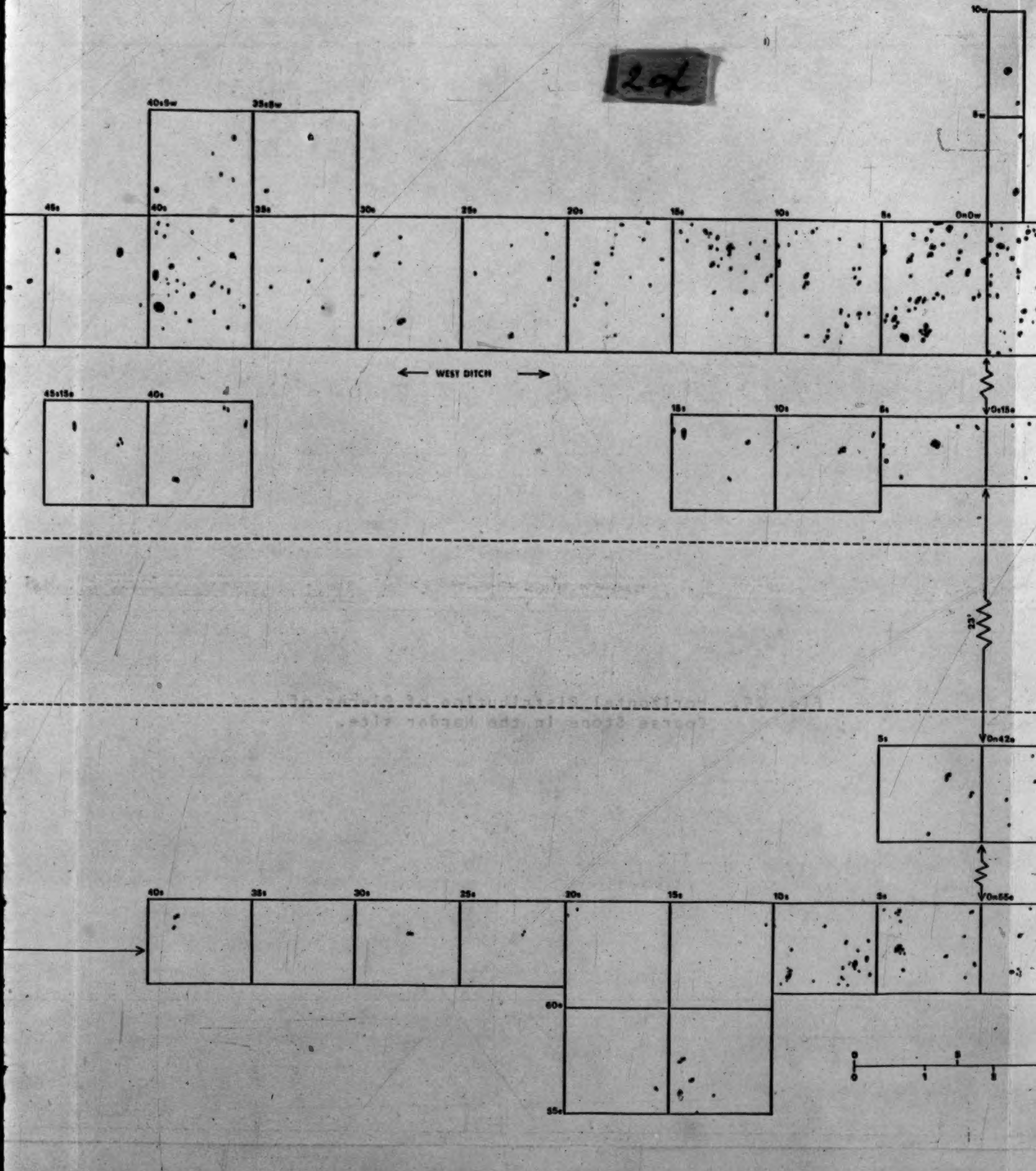
2 of



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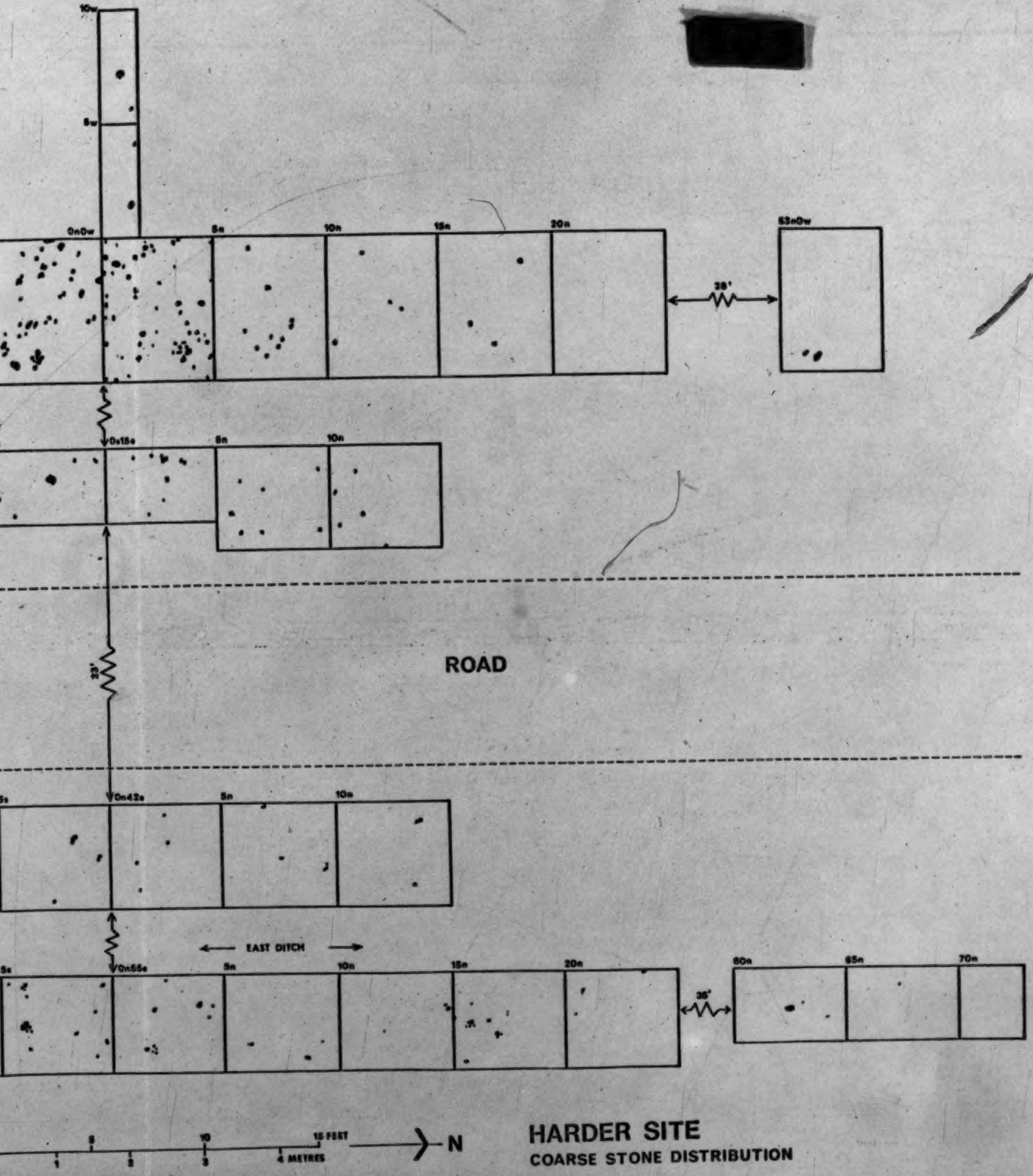
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EAST DITCH
5s
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10n
15n
20n
35'
60n
65n
70n
5
10
15 FEET
1
2
3
4 METRES
N

HARDER SITE
COARSE STONE DISTRIBUTION

other received more exposure in units 0w0-15s. The two large concentrations of other kinds of materials such as chipped stone, bone, and carbonaceous-ashy soil, while the three patch concentrations seem to have been peripheral to concentrations of other materials.

Possible Functions

A number of everyday prehistoric tasks could have involved use of coarse stones. Consideration of these jobs may supply clues to the function(s) of Harder site specimens. The following possibilities are derived from historic descriptions of Plains Indian practices.

1. Boiling Stones. Speaking about Assiniboine Indians and the peculiar cooking method after which they were named, William Francis Butler (1968:278) made the following comment in 1872:

> Their manner of boiling meat was as follows: a round hole was scooped in the earth, and into the hole was sunk a piece of raw hide; this was filled with water, and the buffalo meat placed in it, then a fire was lighted close by and a number of round stones made red hot; in this state they were dropped into, or held in, the water, which was thus raised to boiling temperature and the meat cooked.

As Wissler (1927:76-7) notes, the same method was known to the Arapaho, Crow, Dakota, Gros Ventre, Blackfoot, and Assiniboine, and doubtless was a general practise elsewhere in the Plains. It should be noted that as well as being a variant of meat cooking, this technique was essential to bone boiling.

2. Roasting Stones. An excellent account of the use of stones for meat roasting was given by Buffalo-bird-woman, a Hidatsa woman, born in 1840 (Wilson 1924:268):

> Five or six stones were placed around the fire; upon these we roasted meat. We never used white stones, for they cracked with the heat. The stones were placed far enough apart so we could roast the thigh bone of a buffalo before the fire....the two ends resting on two stones.

From this it appears that cracked fire-stones were known to Indians and something they tried to avoid by selecting proper stones. The white stone mentioned presumably was limestone which does crack and sometimes explode when chemically bonded water is driven off by intense heat.

3. Large Hammerstones. Before the introduction of the blunt-ended steel axe, grooved stone mauls were used by Plains Indians to drive tent pegs, beat meat, and break bones. Mandelbaum (1940:214) claims that several stone mauls and hammers, all grooved, were part of the household equipment of every woman.

4. Anvil Stones. The use of an anvil stone for breaking bones has been mentioned in ethnographic observations (Leechman 1951; Zierhut 1967; Bonnichsen 1973), We may also imagine that an anvil was used in some stone chipping techniques. Presumably a coarse stone with an unbroken cortex would suit this purpose.

5. Chipping Hammers. Small ungrooved pebbles, pitted at the ends and sometimes along the sides, have been found in many archaeological sites and are believed to be stone chipping hammers used in the chipped stone reduction process, particularly in the early stages. One broken chipping hammer was discovered at the Harder site (See Plate 24k). It is a fine-grained silicified sandstone pebble, originally oblong with a shape apparently somewhat like a large blocky egg. Pitting occurs at the centre of one end.

6. Wood, Bone and Chipped Stone Abraders. Coarse stones served the purpose of metal files, sandpaper, and a variety of other abrasives in prehistoric times. Abraded pieces of chipped stone (for example abraded striking platforms and edges of certain tools) were found in the Harder site, but it is not clear what sort of abrasive was used. Another example of the use of abrasives is the long polished tips of split bone awls. Again, the exact kind of abrasive used is not readily apparent by any special shape or modi-

fication of coarse stones left at the site.

One specimen (Plate 25 b) is a possible candidate for one or, perhaps, several types of abrasion. It is a large thick flake of fine-grained pink sandstone, with a crushed bifacially chipped edge. What is important from the present viewpoint is that it also has a broad shallow groove across one end. If it were not for the bifacial edge, one might think the specimen represented a piece of shatter off the end and side of a grooved maul. The bifacial edge, however, indicates that the specimen was used in its present shape, and the groove may be due to an abrasive function ratherthan modification for hafting.

7. Skin Abraders. Plains Indian women were famous for skill in soft-tanning buffalo and deer hides for robes, soft bags, clothing and so on, a skill involving a great deal of hard work. Denig (1929:541) has estimated that at least three days were required to prepare one buffalo robe for market. The work was not only laborious but also complex, calling for a variety of tools and materials and a set of nine sequential procedures. Soft tanning required (1) staking and fleshing the hide; (2) stretching and drying it; (3) scraping the inside; (4) scraping off the hair (optional); (5) grease or oil being thoroughly rubbed in; (6) soaking and pickling (tanning) the whole hide; (7) cleaning with water; (8) heating, drying, and graining with an abrader; and finally (9) flexing over a taut sinew or pole. Stage eight, particularily graining with an abrader, is of interest to us here.

Writing about the Assiniboine in 1854, Denig (1929:541) refers to a rubbing stone and the amount of rubbing required for each hide:

> A fire is then made near and the skin slowly heated and rubbed with a pumice stone or porous bone until it is about half dry, then taken out of the frame and drawn backward and forward round a strong cord of sinew which is tied at each end to the ledge pole. Every few minutes the skin is held a short time to the fire, then rubbed, and this operation continued until it becomes perfectly dry and soft. ...A good hand will rub two whole skins or four halves in a day. (emphasis added)

Speaking about the Plains Indians in general, Wissler (1927:61) confirms that stones were in common use as hide abraders:

> After this, come the rubbing and drying processes. The surface is vigorously rubbed with a rough-edged stone until it presents a clean-grained appearance. The skin is further dried and whitened by sawing back and forth through a loup of twisted sinew or thong tied to the under side of an inclined tipi pole.... As this and the preceding rubbing are parts of the same process their chronological relation is not absolute, but the usual order was as given above. (emphasis added)

Skin abrading, then, is yet another use to which the pieces of coarse broken rocks in the Harder site may have been applied. The question now arises - out of several possible uses for coarse stones, which are most likely for the Harder site?

Probable Functions

There is no doubt that some of the coarse stones brought into the site were used as small hammers, for part of a small chipping hammer was recovered among the remains. It is very unlikely, however, that all of the coarse stone debris was derived from this source partly because some of the material was unsuitable for this use and partly because it is hard to imagine a need for so many hammers. Furthermore, it is unlikely that chipping hammers would have broken into so many small pieces. Thus, it seems reasonable to allow only a very minor portion of coarse debris as potential but unrecognizable small hammerstones. Likewise, although there is a strong probability that some coarse stones were used as abrasives in the manufacture of other tools such as projectile points, arrowshafts, and sharp-pointed bone objects, and there is even one item with a groove that might be due to such use, it is unlikely that broken tool abraders account for anything but a small quantity of the coarse stones in the site.

Complete stone anvils were not present and fragments with a pecked or crushed flat surface that might have been part of an anvil-stone were not seen. Yet it is possible that pieces of anvil stone could show little sign of use. With this in mind, I re-examined the bone, chipped stone, and coarse stone distributions to see if there was a correlation between coarse stone, particularly large tough pieces, and either of the other two materials, the underlying assumption being that if some of the coarse stones were, indeed, pieces of anvil-stones, then they might still be in close proximity to debitage from material that had been broken upon them. No such configuration was found. At this point, with only negative evidence at hand, the question of potential for anvil function is unresolved.

Large hammerstones were not present as complete or even nearly complete specimens. But the coarse stone debris does include some large fragments of tough stone with large chip scars emanating from a former end position. Such fragments may have been ends of large (greater than 500 g) hammerstones. With 5% to 10% of the large fragments showing this evidence and there being possibly two or three fragments without wear for every broken hammerstone, I estimate that 10% to 30% of the large coarse stones might have been large hammerstones.

The unaccounted majority includes several dozen large and many medium and small pieces. The same group can be sorted according to the resistance offered to a crushing force. Perhaps 35% to 40%, if placed upon an anvil and struck heavy-handed blows with a three pound hammer, would offer considerable resistance to breakage, the kind of toughness one would expect if he tried to smash normal granite cobbles. I refer to this state as normal. An additional 45% to 55% of the sample would break into pieces with the same hammer and anvil, but with only a few light blows. This condition is referred to as cracked. And the final 5% to 10% could be crushed in a man's hand. This is crumbly rock.

Breakdown of the internal strength of rocks followed by degradation is a common but varied natural process known as weathering. In the opinion of experienced geologists (E. A. Christiansen and C. Dunn, personal communication) certain cracked and crumbly rocks like some specimens at the Harder site are in a weakened condition beyond 'natural' weathering. Extreme heating or cooling and rapid changes of temperature could account for this unusual degree of weathering. The cultural circumstances that come to mind, of course, are the practices of stone boiling and stone roasting. Coarse, granular stones such as granite and sandstone should be superior, theoretically, to chert, quartzite and limestone for both roasting and boiling because the looser internal structure of the former can accommodate more expansion and contraction stresses, especially uneven ones. This characteristic is important because it means that a coarse stone could be used for boiling or roasting. Unlike finer grained materials that might crack violently after being submerged red hot into cool water, coarse rocks would probably weaken much more gradually allowing many uses before being cracked so badly that they began to fall apart. Thus, internal structure of the majority of coarse stone (granite and sandstone) and extreme physical weathering reasonably attributed to unusual heating and cooling stresses are both supportive of the notion that most of the coarse rocks were used for roasting and boiling purposes. If this is so, then the high degree of breakage indicates that use of stones was intensive, prolonged, or perhaps both.

By interpreting a small part as hammerstones, bone and chipped stone abraders, anvil stones and chipping hammers, and a large part as roasting and boiling stone detritus, virtually all coarse stone can be accounted for without recourse to the hide abrader function. But, in view of the high percentage of small end scrapers suggesting the prominence of skin working at this site, it would be improper to bypass the possibility that some of the coarse stone was related to hide preparation. The problem then becomes 'what does stone hide abrader look like?', since, to the best of my knowledge, stone hide abraders have not yet been identified by archaeologists.

At a number of late prehistoric sites in the central and north-eastern Plains, certain pieces of spongy bone have been called hide grainers or abraders. Usually these specimens are thin half-spheres sheared from the heads of bison humeri so that a large surface of cancellous tissue is exposed opposite a dome-shaped articular surface. Considerable grinding and wear may be found on the spongy surface (lehmer 1954:111, 1971:158-59; Falk 1969:40). Certain stone disks and rectangles often made of tabular sandstone and found mainly in Middle Missouri northern Post-Contact Coalescent sites (Lehmer 1971:150-51) seem to be a very close stone equivalent to the humeri hide abraders. Perhaps these were the hide rubbing stones seen by fur traders and early ethnographers.

At the Long Creek site in the middle prehistoric Oxbow components a different kind of bone rubbing tool made from split bison ribs rubbed smooth at one end was found and interpreted as a skin softening tool (Wettlaufer and Mayer-Oakes 1960:64). Similar tools from European Upper Paleolithic sites have been called bone burnishers and are believed to have been used to compress the skin after greasing and rubbing to make it prettier, tougher and more impermeable (Semenov 1964:175-79). This burnishing tool is not, I believe, functionally equivalent to the hide abraders described above. In fact, abrading and burnishing are probably separate operations; at least they appear to have been so since early historic times. A modern tanner talks about his second last procedure, after oiling or greasing, as breaking down the hide (R. Tillie, personal communication). The breaking down is done with a coarse metal rasp and is meant to break as many of the surface fibres as possible to make the hide pliable. The final step, called working the hide over the beam, involves pulling the hide, a small area (approximately 7.5 cm by 12.5 cm) at a time, over the edge of a 0.35 cm thick metal plate (the beam) until it is soft and finished.

In early historic times Indian hide workers accomplished the same operations by rubbing the hide with a porous piece of bone or stone and then pulling it over a leather thong. It is probable that the burnishing tool, in spite of Semenov's (1964:179) claim that it was the only possible tool for this function, was replaced by the thong sometime in late prehistoric or early historic times. If the implication that the burnisher is equivalent to the thong (and later the beam) is correct, then we should find stone or bone hide abraders in addition to burnishers in middle and early prehistoric sites. This point brings us back to coarse stone.

At the Harder site the closest thing to the bone hide abraders of the Middle Missouri and Central Plains is a large sandstone specimen described earlier (p.158 and Plate 25 b). In addition to chipped edges and shallow groove across one end, the specimen has a slightly convex rough ventral surface corresponding to the exposed cancellous tissue surface of the bone abrader. No ventral wear can be seen, no doubt because the grainy surface is not conducive to such observations; but the edges are smoothed and rounded as with bone abraders. Moreover, chip scars emanating from the edges seem more obscured on the ventral surface than they are on the dorsal surface, suggesting the ventral surface was subject to wear. Thus there is at least one good candidate for the class, hide abrading tools, at the Harder site.

At the same time, it seems that many large pieces of split coarse stone could have served the same purpose and, indeed, if end scrapers are an indication of the amount of hide working, many rubbing stones should have been required. With this in mind, I re-examined coarse stone fragments large enough to be hand-held and with a rough but relatively flat surface in an attempt to find some definite signs of wear. Unfortunately the results were inconclusive. Some pieces have edges and promontories that are slightly rounded; others have not. Consequently, the potential for stone hide abraders as a major functional supplement or alternative to the use as roasting or boiling stones at the Harder site remains vague, but intriguing.

CARBONACEOUS-ASHY SOIL

Introduction

Marked colour changes were observed on various parts of the living floor. In a few instances a small dark patch of soil stood in stark contrast to surrounding lighter soil, defining a feature (For example, see elongate black and grey hearth in unit 0w105s, Plate 14). More often the change was gradual and one could see, over quite large areas, meandering blotches in low contrast to the surrounding surface (for example Plate 28). On a larger scale yet, some regions of the site bore mainly a black-brown or black-grey sandy floor while neighbouring sections of the same occupation surface might be pale yellow in colour (See adjoining excavation units in Plate 29). Throughout investigations at the Harder site, such soil colour changes were an elusive object, often a little out of focus no matter how close up or far back one stood. Reasons for the colour changes are not perfectly clear, and ideas about them have not been tested against physical or chemical evidence from the soil.

Distribution in the Site

The horizontal distribution of soil colours is shown in Fig. 26. Two

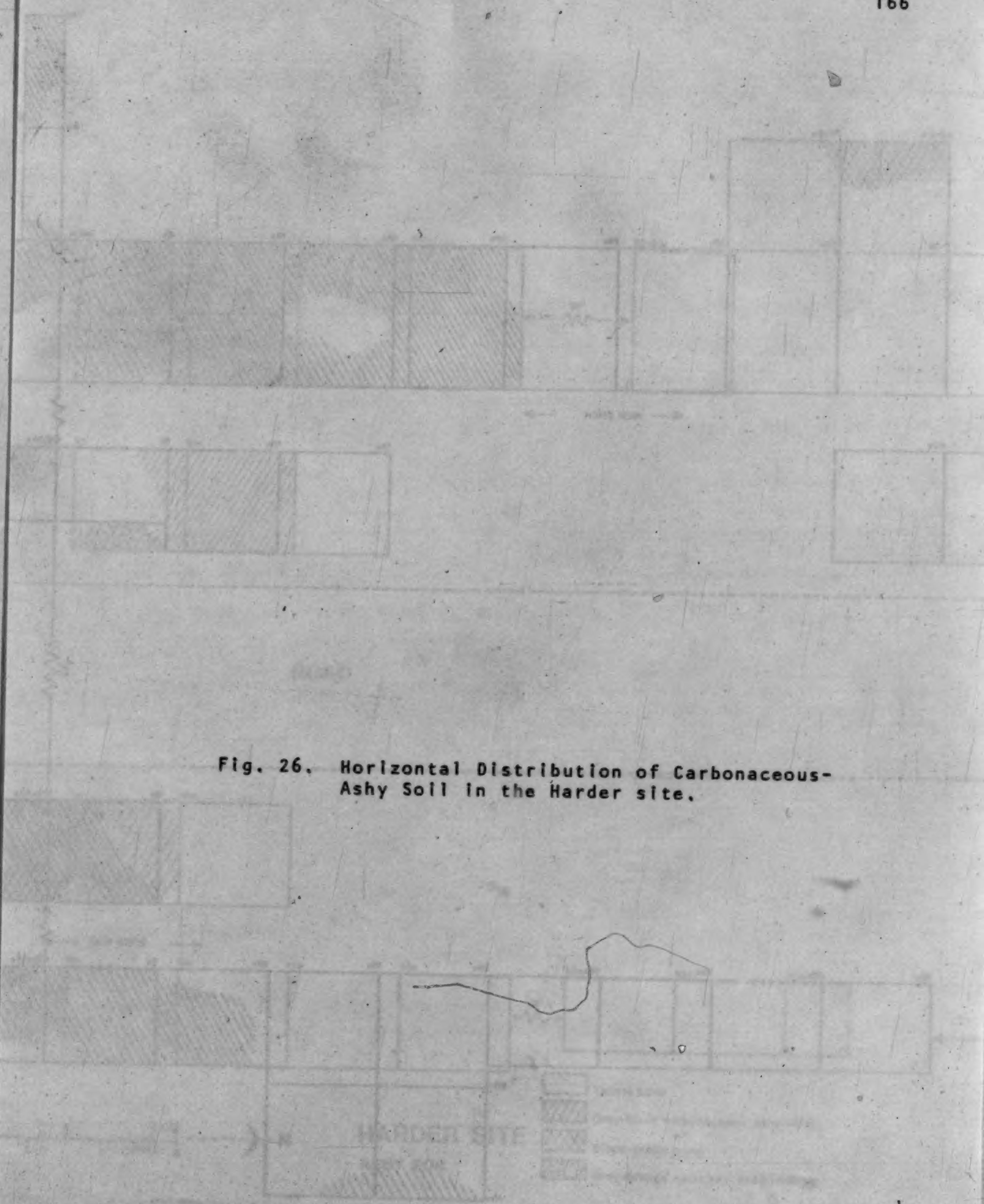
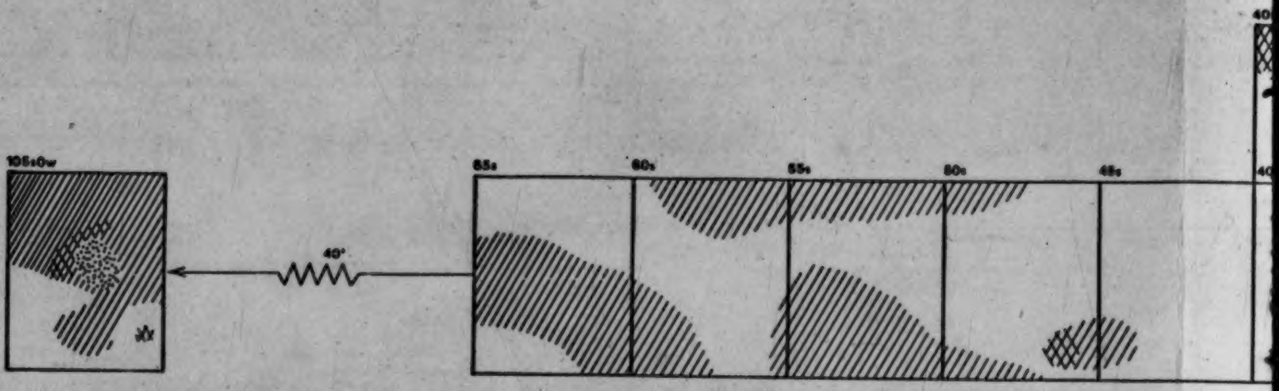
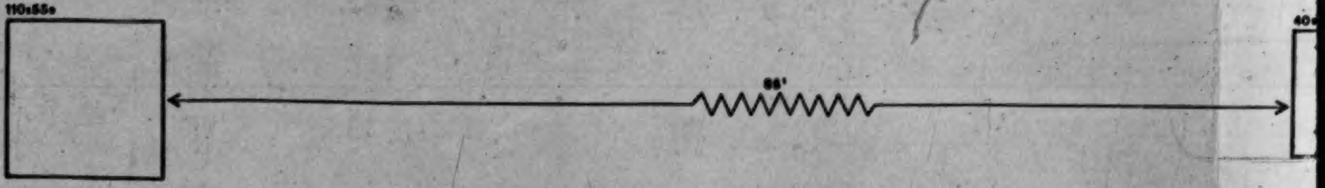

HARDER SITE

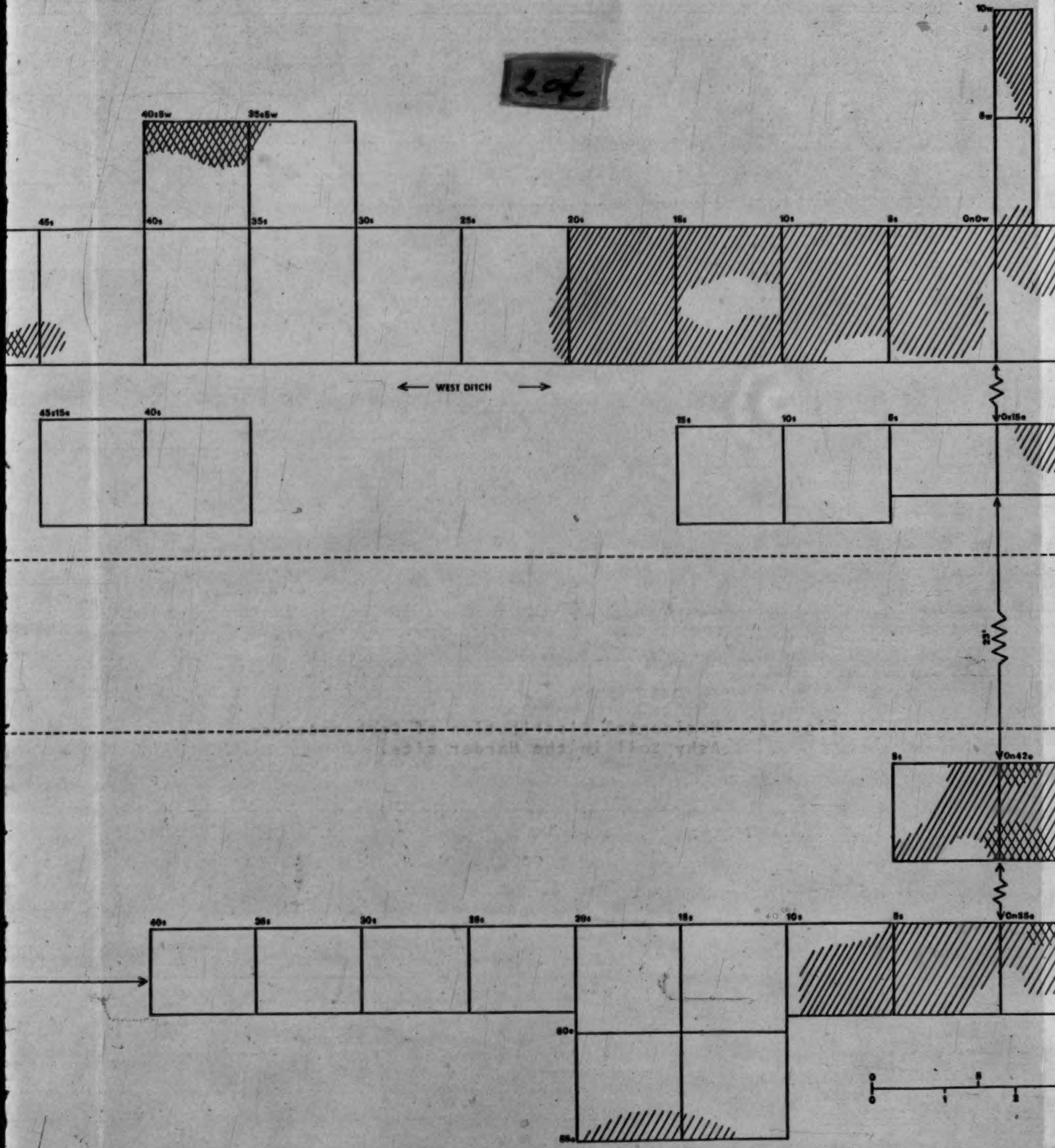
Fig. 26. Horizontal Distribution of Carbonaceous-Ashy Soil in the Harder site.

[redacted]

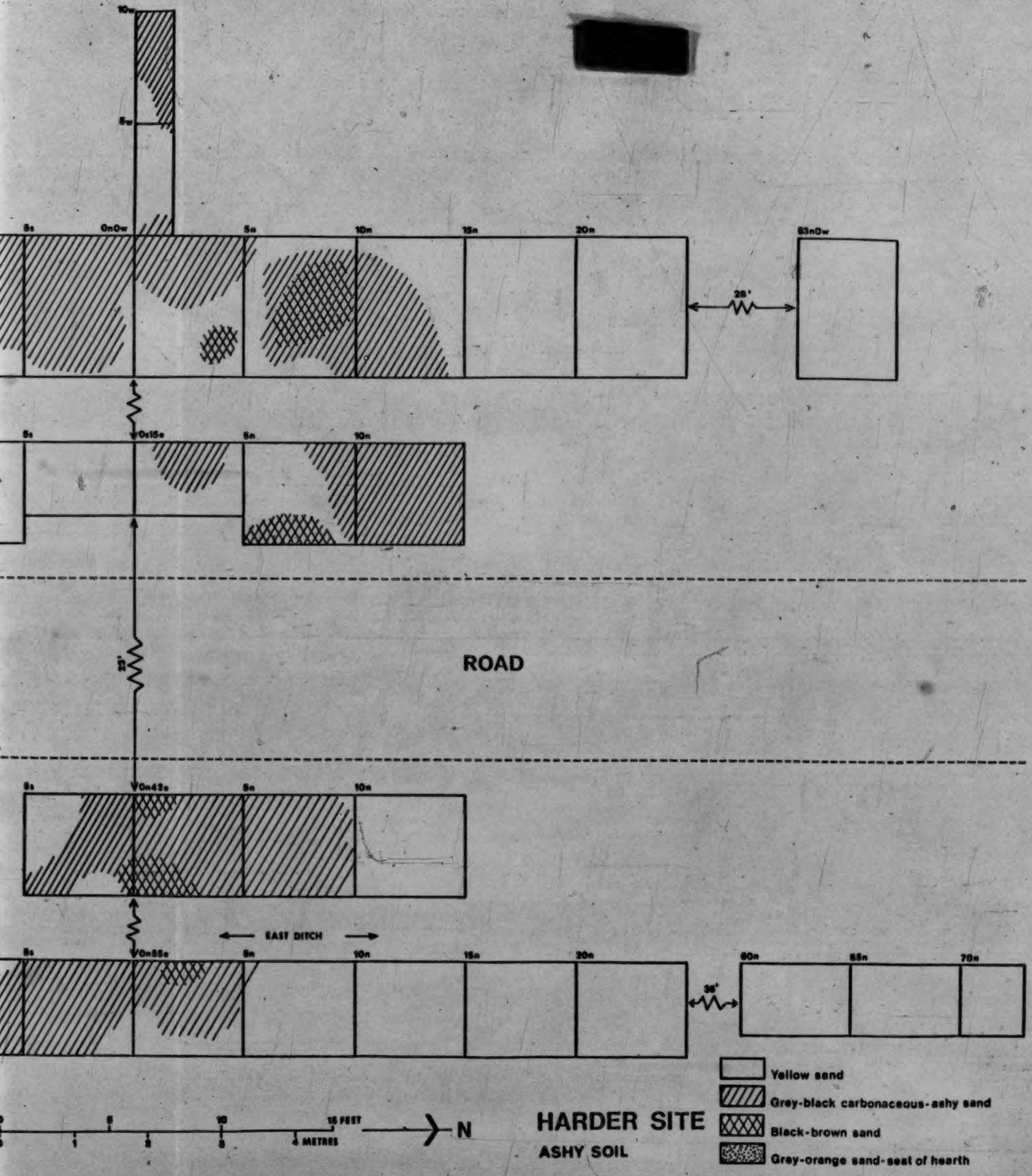

105s0w
40°
65s
60s
55s
50s
45s
40


110s55e
65°
40s

2of


10w
5w
40s5w
35s5w
45s
40s
35s
30s
25s
20s
15s
10s
5s
0n0w
WEST DITCH
45s15e
40s
15s
10s
5s
0s15e
23'
5s
0n42e
40s
35s
30s
25s
20s
15s
10s
5s
0n55e
60e
85e
0
5
0
1
2

[redacted]


10w
5w
5s
0n0w
5n
10n
15n
20n
53n0w
25'
0s15e
5s
5n
10n
ROAD
23'
5s
0n42e
5n
10n
EAST DITCH
5s
0n55e
5n
10n
15n
20n
36'
60n
65n
70n
0 5 10 15 FEET
0 1 2 3 4 METRES
N

HARDER SITE

ASHY SOIL

- ☐ Yellow sand
- ▨ Grey-black carbonaceous-ashy sand
- ▩ Black-brown sand
- ▒ Grey-orange sand-seat of hearth

colours predominate, namely, pale slightly dirty yellow which seems to be the 'natural' colour of the sand at this level, and black-grey, believed to be an organic-ashy residue left from some aspect(s) of occupation, possibly a floor dirt mixture of carbon, ash, sand, grease, and so forth. Third is a black-brown sand of unknown origin found in patches, ovals, and circles superimposed either on black-grey or yellow sand. Finally, a thin lens of grey ashy sand with a slight salmon-pink hue is believed to be the seat of a small hearth. The border between one colour and another was sometimes distinct although the contrast might be either high or low, but more often indistinct while the contrast might still be either high or low.

With yellow sand as background, one's attention is caught by black-grey, black-brown, and grey-orange colours which, for present purposes, are collectively referred to as carbonaceous-ashy soil. The largest and most nearly continuous area of carbonaceous-ashy soil was exposed in adjoining units 0w20s to 0w10n. Within this area a greyish hue was quite noticeable in unit 0w20s and pronounced in units 0w5s and 0w10s as if there had been considerable ash there. An oval of black-brown soil was seen in unit 0w0n and a larger patch of the same was in the next unit in direct association with Bone Pile I. The whole of this large carbonaceous-ashy area corresponds closely to the area of LAF I. Patches and parts of other carbonaceous-ashy areas were recorded in units 0w65s to 0w45s (including a patch corresponding to Bone Pile II), 5w40s and 5w35s, 10w0n, 15e0n, 15e5n and 15e10n, 55e10s, 55e5s, 55e0n (including an oval corresponding to Charred-white Bones II), and 60e20s and 60e15s. These observations were either incomplete or indistinct and consequently do not lend themselves to extrapolation to large area features they may be associated with. Two other areas of carbonaceous-ashy soil, however, do invite such extrapolations.

One was situated in the centre of units 42e5s to 42e10n and comprised an area of black-grey sand some 4 m across, standing in high contrast to surrounding pale yellow sand. The contrast between yellow and dark sand was somewhat greater here than elsewhere in the site. Included within this larger feature were two patches of black-brown sand partly underlying areas where large broken bones were concentrated. The boundary of dark soil in this large feature does not make a perfect overlap with other materials concentrated in this area, but being very noticeable, it was used as the boundary in defining Dwelling Floor, Feature 12 (See Fig. 27).

The other complex of carbonaceous-ashy soil, situated in unit Ow105s and spreading an undetermined distance beyond, includes a small hearth and smudge pit centred in the excavation unit excavated last. Although in many parts of the site hearths are suspected by black-grey sand, only in this unit can one be sure that the exact location is known. An elongate patch of grey sand with a pink-white hue cross-cut with a black band of sand and bordered to the immediate north and southeast with large pieces of coarse rocks is taken as the seat of the hearth (Feature 3). Sprinkled in and around it but especially thickly concentrated 25 cm to the east were burnt white comminuted fragments of bone indicative of a hot fire. Interspersed with the thick concentration of white bone fragments east of the hearth is an oval of black-brown sand whose boundary is taken as the perimeter of the small feature, including Charred-white Bones 1, believed to be a smudge pit. Beyond that to the north were three indistinct black-brown dots 8 to 15 cm in diameter and 10 to 15 cm in depth. These small features were in a position to be postmolds for props associated with the smudge pit or hearth.

Thus, carbonaceous-ashy soil residues appear to be associated with occupational features. This conclusion is based on the shape of residue deposits, correlation with concentrations of other materials, and on absence of the residues outside the site and also absence from certain areas inside. The idea that soil residues might be differentiated into types related to several different features only became clear during analysis of field records after excavations were completed. An unfortunate, but unavoidable result is that soil samples were not collected in a manner that will allow any tests of the above postulations.

In future work it should be possible to study such soil residues profitably. Other investigators have noticed, for example, that decayed organic material can form a permanent 'micropodzol' around a feature in an acidic sandy subsoil, and that organic residues can leave a blackened appearance similar to mineralized iron and manganese (Biek 1969:119). High pH values have been used at some sites to define the perimeter of occupation (King 1976). In some cases phosphate analysis has been found useful for locating concentrations of decayed organic material (Biek 1969:120). Interested readers will find an excellent review of the potential and problems associated with archaeological soil analysis in Limbrey's (1975:281-334) new book, Soil Science and Archaeology. One caution stressed by all workers is that soil analysis in archaeological sites is often complex and can only be fruitful if samples and tests stem from good hypotheses formulated in the light of careful observations. That important first step has been taken at the Harder site.

FEATURES

INTRODUCTION

According to Binford (1964:431), "cultural features are bounded and qualitatively isolated units that exhibit a structural association between two or more cultural items and types of nonrecoverable or composite matrices." Thus, features are complex artifacts including such often recognized remains as burials, walls, pits, hearths, and mounds as well as other organized remains not yet recognized. Additional observations cannot be made after features have been dissected but careful analysis of field records may indicate the presence of a feature not recognized in the field. In spite of the attention given to portable artifacts, features are an extremely important part of the archaeological record, being the interpretive link between small items and whole sites. Furthermore, features should be present in all primary context sites. In view of the role of features for interpreting activities within sites, isolation of them is crucial.

Some 13 cultural features have been isolated and identified at the Harder site, ranging in size from 20 by 40 cm smudge pits to dwelling floors 6 m in diameter. Except for the hearths, none is commonly known; and most were recognized at the end of excavations when separate mosaics were compiled for large bone fragments, pulverized bones, coarse rocks, chipped stone debris, chipped stone tools, and carbonaceous-ashy matrix. From the beginning of excavations, I watched carefully for features such as bone boiling pits and associated throw-away areas (Losey 1971), bone breaking areas (Frison 1967), and articulated bones representing butchering units (Wheat 1972); but they did not appear. At the end of excavations I had only isolated two small pockets of charred-white comminuted bones (later identified as smudge pits) and two small concentrations of large bone fragments (later identified as bone pile and a hearth-refuse area); and I had a fuzzy notion about the positions of several large general concentrations of material (later identified as dwelling floors). But laboratory analysis of field records eventually led to the definition of yet other features which, when isolated and identified, became obvious. When similar features are seen in other sites, highly relevant data I missed will probably be collected.

Harder site features are classified and numbered in Table XV and mapped in Fig. 27. The following sections comprise a detailed analysis of feature attributes in a justified functional classification that includes ethnographic and archaeological analogies in support of the functional hypothesis for each class (except hearths which are described in Chapter V). Emphasis is placed on bone components because of the special importance of bone material for identification and interpretation of most features.

SMUDGE PITS

Features 1 and 2, the smallest features found, both appear to be smudge pits. Their important characteristics are given below.

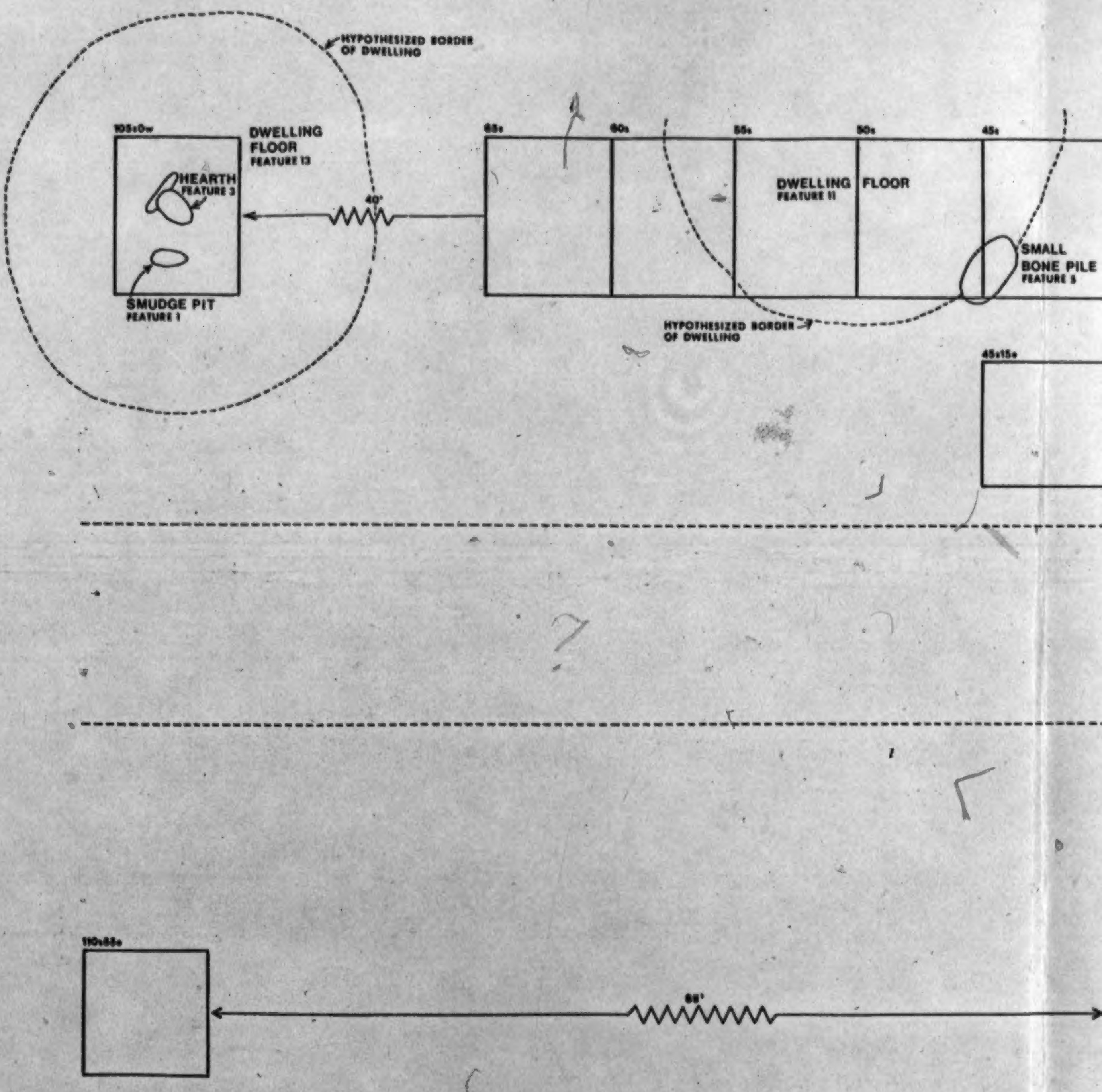
Size

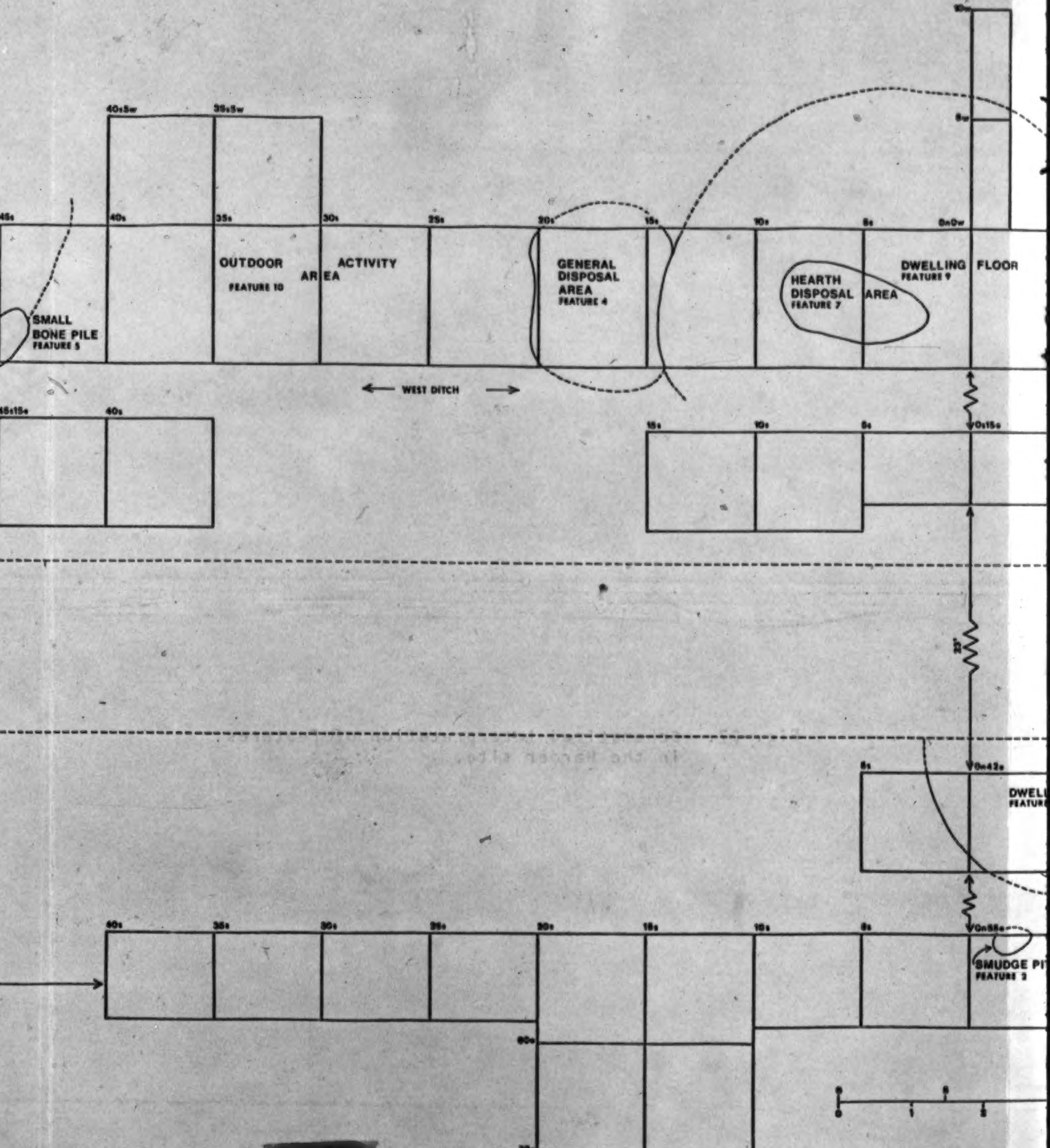
Horizontal dimensions ranged from 38 to 40 cm in length and 18 to 20 cm in width. Thickness ranged from 10 to 15 cm.

Shape

In a horizontal plane the features were oval. They were not sectioned in the field, so direct observations on their vertical profile are not avail-

Fig. 27. Schematized Interpretation of Features in the Harder site.


HYPOTHESIZED BORDER OF DWELLING
105s0w
DWELLING FLOOR
FEATURE 13
HEARTH
FEATURE 3
SMUDGE PIT
FEATURE 1
40'
65s
60s
55s
50s
45s
DWELLING FLOOR
FEATURE 11
SMALL BONE PILE
FEATURE 5
HYPOTHESIZED BORDER OF DWELLING
45s15e
110s85e
65'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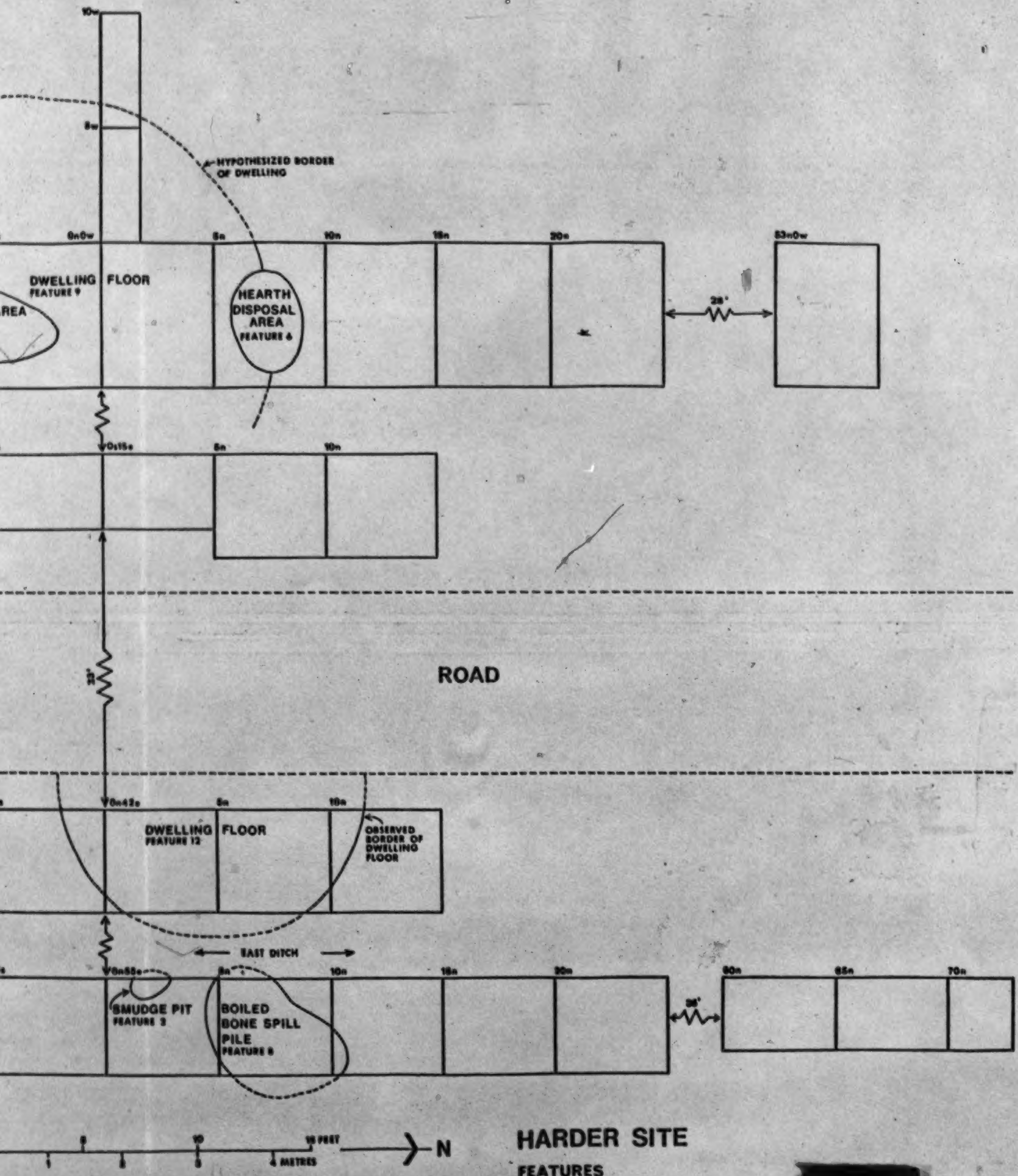
35s5w
10w
5w
45s
40s
35s
30s
25s
20s
15s
10s
5s
0n0w
OUTDOOR ACTIVITY AREA
FEATURE 10
SMALL BONE PILE
FEATURE 5
GENERAL DISPOSAL AREA
FEATURE 4
HEARTH DISPOSAL AREA
FEATURE 7
DWELLING FLOOR
FEATURE 9
WEST DITCH
45s15s
40s
15s
10s
5s
0s15s
22'
5s
0n42s
DWELL
FEATUR
40s
35s
30s
25s
20s
15s
10s
5s
0n58s
SMUDGE PI
FEATURE 2
60s
80s
0
1
2
5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8w
HYPOTHESIZED BORDER OF DWELLING
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5n
10n
15n
20n
53n0w
DWELLING FLOOR
FEATURE 9
AREA
HEARTH DISPOSAL AREA
FEATURE 6
28'
0s15e
5n
10n
ROAD
33'
0n42e
5n
10n
DWELLING FLOOR
FEATURE 12
OBSERVED BORDER OF DWELLING FLOOR
EAST DITCH
0n58e
5n
10n
15n
20n
60n
65n
70n
36'
SMUDGE PIT
FEATURE 3
BOILED BONE SPILL PILE
FEATURE 8
5
10
15 FEET
1
2
3
4 METRES
N

HARDER SITE

FEATURES

[redacted]

TABLE XV

HARDER SITE FEATURES

Class	Feature Number	Bone Component (See Appendix I)
smudge pits	1	Pt C-W BI
	2	Pt C-W BII
hearth	3	---
general disposal area	4	BP III; PB III
small bone pile	5	BP II
hearth-refuse area	6	BP I; PB I
boiled bone spill pile	8	PB IV
dwelling floors	9	LAF 1
	11	LAF 2
	12	LAF 4
	13	LAF 5
outdoor activity area	10	LAF 3

Note: Abbreviations used are:
Pt C-W B = Pocket of Charred-white Bone
BP = Bone Pile
PB = Pulverized Bone
LAF = Large Area Feature

able. Fortunately, successive planviews and colour slides give an impression of the probable section. Plans line up one on top of the other and the size of the feature remains nearly the same or diminished slightly from top to bottom. This appearance suggests (a) that the feature was a pit or basin rather than an above-surface pile, and (b) that the sides were nearly vertical, sloping inwards toward the bottom.

Elements of the Feature

(1) Charred-white bone segments. The segments were the remains of highly pulverized large bones - mainly shafts. Segments were tiny gener-

ally 1 to 2 cm in length and about 0.5 cm in both width and thickness. They were charred-white or white-blue in most cases, but some were charred-black in the centre and white at the edges. By volume, charred-white segments made up about 15 to 20% of the total contents of each feature.

(2) Black to dark brown soil matrix. The matrix of these features was a black or dark brown porous and soft sandy "soil" which was clearly distinct from the normally yellow-grey packed sand occupation matrix. No small twigs or seeds or pieces of charcoal were seen intermixed with the "soils", yet visually it appeared that the organic content was very high. Black to dark brown soil made up 80 to 85% of the contents of the feature by volume.

Distribution of Elements Within the Feature

Charred-white bone fragments were mixed throughout the features with slightly more pieces toward the top. Black "soil" was also mixed throughout. No microstratigraphy could be discerned.

Relation to Other Features

The relation of Smudge Pit I to other features is known only from the limited exposure of excavation unit 0w105s. The west half of the unit was occupied by a concentration of coarse stones, large pieces of broken bones, comminuted bone, and small chipped stone flakes, in a matrix rich in carbonaceous-ashy remains. Among the materials in the west half was a feature about 30 cm in diameter and comprised of a pink-white ashy lens and cross-cut by a band of black sand which is believed to be a hearth. Several large dots of carbonaceous-ashy soil were near the smudge pit. The largest, located about 20 cm beyond the northeast edge of Smudge Pit I, was about

15 cm in diameter and more carbonaceous than ashy, with a depth of about 10 to 15 cm.

Smudge Pit 2 was on the edge of the ditch, and in fact was partly distributed by ditch excavations immediately west of it. South of the smudge pit was a thin concentration of coarse stones, large pieces of broken bones, comminuted bones, and chipped stone flakes together with a concentration of five end scrapers. Northeast of the smudge pit some 40 cm away was a concentration of uncharred comminuted bones believed to be a boiled bone spill pile. Yellow sand with little cultural material stretched eastward at least one meter to the edge of excavations. A piece of coarse rock and two large pieces of uncharred broken bone lay immediately north of the smudge pit.

General Observations

The smudge pits appeared to have been abandoned without disturbance. In both cases, there was a little charred-white bone and black soil scattered outside the feature: In the first case the scatter was to the northeast and formed an almost separate, but very diluted, concentration at a distance of about 35 cm; Smudge Pit 2 included a thin scatter to the northwest which was truncated by the ditch 20 cm from the edge of the feature. There was also a small discrete scatter about 10 cm southeast of the feature. Those scatters suggest that during (or after) use some of the contents of the pit were removed by whisking off the upper part and depositing it to one side. Otherwise the features appeared to be intact.

Postulated Function

It seems probable that these features were the remains of small fire pits. Whether they were meant for heat or for smoke or for both was puzzling at first because the elements present seem to suggest extremes of both heat and smoke, an unlikely combination in one small pit. The predominantly black soil suggests burning of a good deal of fine organic matter such as punk wood or buffalo dung, possibly in an oxygen starved atmosphere or possibly using damp fuel. Either situation would probably create a good deal of smoke but little heat. If the nearby hearth and smudge pit were coeval, heat would no doubt have been amply available at the hearth. Nevertheless, the highly calcined condition of the comminuted bone mixed with the black soil suggests extremely high temperatures (Binford 1972:384).

It is possible to explain both observations with the postulate that the pits were meant to produce smoke, not heat (therefore the predominance of black organic soil); that the main fuel was not fast burning and perhaps damp, so that in order to keep the burning action going a few redhot comminuted bone segments were occasionally sprinkled on top. The bone segments would not burn to ash in the pocket as they would in the hearth, but would be left in a calcined state.

Discussion

It is postulated that Harder site Features 1 and 2 were smudge pits for hide smoking. The archaeological evidence fits with ethnological observations (See Appendix IV), similar characteristics being shape and size, lack of disturbance, and similar contents (burned bark, twigs, rotten wood, dung and sage ethnographically; and carbonized organic soil at the Harder site). The small quantities of calcined bone in Harder pits are explained as a hot-burning additive to poor-burning but smoky material. There is little evidence for a special apparatus to suspend hides over the pits as was found at the Long Creek site (See Appendix IV). The sandy matrix at the Harder site may not be conducive to preservation of small peg and post molds or, alternatively, a special hide suspension apparatus may not have been needed if the pits were inside dwellings where hides could have been suspended from dwelling supports. The Harder pits are at the shallow end of ethnographic pit depths which may indicate that the smudge pits were sheltered or inside dwellings (See Appendix IV).

BOILED BONE SPILL PILE

Five of six concentrations of pulverized bone seem to be elements of larger features. Pulverized Bones I and II (See Appendix I) are parts of two bone piles. Pulverized Bones II, V and VI are parts of large area features. The five concentrations are best considered below with larger features. This leaves one concentration, Pulverized Bones IV, an isolated feature comprised entirely of comminuted bone. This feature is considered as a single member of the class, Boiled Bone Spill Piles. Important characteristics are outlined below.

Size

Horizontal dimensions were 2.1 m in length (this measurement may be too short as the feature overflows the excavation unit), by 1.3 m in width. The thickness was estimated at 8 - 10 cm.

Shape

In a horizontal plane the feature was oblong with its long axis oriented northeast-southwest. The boundaries were not clear in the field excavation; and therefore, only general location and shape were noted. The thickness deduced from the plan views suggests an even layer of comminuted bone at approximately the same level as the Oxbow occupation surface.

Elements of the Feature

(1) Uncharred comminuted bone. The concentration of pulverized bones at this location was somewhat different from faunal remains elsewhere in the site. Fragments and segments were mainly buff-coloured, with about 30% having an orange to dark brown mottled stain, and only about 5% showing any signs of charring. Although extensively broken, many pieces were identified to type and bone region. The collection is dominated by bison front limbs from shoulders to hoofs. All bones from the head of the humerus to the third phalanx appear, with predictably higher numbers of small compact bones such as carpals surviving intact. A minimum of one right and two left front limbs were present. A few pieces representing other regions of the body were also found, namely, one fragment of the distal left tibia, one right lateral malleolus, six segments of innominate, one rib segment, one segment of greater cornu of hyoid, two small mandible segments, four teeth, and 20 fragments of teeth.

(2) Medium brown to light brown soil. The matrix associated with the comminuted bone concentration is medium to light brown, with little or no evidence for carbonaceous or ashy material. Toward the edges of the bone concentration the colour of the soil fades into the pale yellow sand characteristic of the lightly occupied peripheries of the site.

(3) Other. Coarse stones (medium and small pieces) were present in small amounts. Chipped stone flakes, mostly small, appeared in slightly higher than average density. One chipped stone tool, a thin uniface, also was found nearby.

Distribution of Elements Within the Feature

Comminuted bone and brown soil matrix were evenly spread throughout the feature. No record was kept of vertical compactness of bone segments, but there was insufficient bone to make a solid layer.

Relation of Boiled Bone Spill Pile to Other Features

The closest known feature was Smudge Pit 2, situated only 40 cm to the southwest. A thin concentration of coarse stone, large broken bones, comminuted bones, and chipped stone flakes in a soil matrix that was dark brown, with patches of carbonaceous ash, was located at the south edge of the smudge pit and extended further south (and probably eastward before the ditch was built). Approximately 2.5 m east, across the ditch, was Feature 12, a dwelling floor.

Postulated Function

This feature appears to have been a discarded batch of broken, boiled bones.

Discussion

Ethnographic accounts show that Indians often brought bones back to camp, broke them for marrow and boiled the broken pieces for bone grease.

Archaeological evidence shows that bone-breaking and boiling also took place at or near kill sites (See Appendix V for relevant ethnographic and archaeological observations). At a kill site where a great amount of bone had to be processed at one time, simultaneous use of several boiling pits would have saved time. Each pit might have been used only once and then abandoned with the remains still in it. But in a camp site where bones were brought in over a period of time, one boiling-pit (per work group) might have done the job if it was cleaned out periodically. Cleaning a bone pit would involve disposal of water, heating-stone detritus (large pieces being saved for reuse) and boiled out bone fragments.

Feature 8 was predominantly buff-coloured bone fragments, with about 30% bearing orange-brown 'stain' probably indicative of bone roasting (to destroy the periosteum prior to breaking), and with less than 5% being blackened or calcined. There was also a small amount of heating stone detritus present. This material is what might be expected in a boiled bone spill pile. Furthermore, Feature 8 was situated only a short distance northeast of an activity complex containing a scatter of the same materials (plus others). Tossing boiled bone, water, and heating stone detritus from the activity complex into Feature 8 could have been done easily. Feature 8 was a flattened horizontal layer on the Oxbow surface, not in a pit below so it could not have been the actual site of bone boiling. Yet, the remains have the same homogeneity found in boiling pits. A boiling pit at the Cormie Ranch site (See Appendix V) contained the pulverized remains of five front bison limbs. Feature 8 contained the remains of three front limbs. Hence boiled bone spill pile seems a reasonable interpretation for Feature 8.

SMALL BONE PILE, GENERAL DISPOSAL AREA, AND HEARTH-REFUSE AREAS

Large pieces of bone were found scattered throughout the site. In most parts they were well scattered, in some places a little thicker, in others a little thinner, but not closely concentrated as if in a purposeful collection. In exception to this overall pattern, at four locations large pieces of bone did appear to be concentrated within medium to small areas. Considerable additional material was found at three of the locations. These four features (Nos. 4, 5, 6, and 7) are postulated to have been a small bone pile, a general disposal area, and hearth-refuse areas respectively. None contained a huge quantity of bones; so at best they were modest refuse areas. Aside from the similarity of concentrated bone, the elements of these features show some differences in presence, absence, and amount of chipped stone debitage, coarse stone, and comminuted bone. Beside pieces of large bone, traits shared by all features were presence of black-grey soil and absence of chipped stone tools or fragments (except for Feature 7). The basic characteristics are given below.

Size

Horizontal dimensions ranged from 46 by 46 to 300 by 200 cm. Thickness was from 8 to 15 cm.

Shape

In horizontal plan Features 5 and 6 were oval, Feature 7 was elongate, and Feature 4 was incomplete. In profile, each was a layer in the same plane as the occupation floor.

Elements of the Feature

(1) Large pieces of broken bone. Feature 6 contained bones mainly from hind limbs of two bison, a few other buffalo parts, and jawbones from two wolves. Feature 5 contained only bison bones, but in an unusual mixture: a few teeth and neck vertebrae, part of one large bone and a few small bones from each of the front and hind limbs. Feature 4 contained a cross-section of the bison bones found in the site, representing a minimum of three animals. The regions best represented were upper parts of both front and hind limbs. A few teeth and skull parts, one neck vertebra, two rib pieces, pieces of left and right pelves, and a few phalanges were also present. Six small bones remain unidentified. Feature 7 was similar to Feature 4 except that it contained more lower parts of front and hind limbs than upper parts. Only a few pieces in each feature had a sooty black surface. Most pieces were the usual buff-colour.

(2) Black-grey carbonaceous-ashy sand. Next to large pieces of broken bone, black-grey carbonaceous-ashy sand was the most obvious attribute of all four features. The edges of features were intruded in some places by yellow sand from the surrounding area.

(3) Comminuted bone. Concentrations of comminuted bones were part of Features 4, 6, and 7 (See Pulverized Bones I, II and III; Appendix I) but none accompanied Feature 5. In instances when comminuted bone did appear, approximately 5% to 10% (by volume) showed some blackness on the surface indicative of charring, about 25% showed a mottled brown-orange surface, and the balance was the usual buff-colour.

(4) Small amount of coarse stone. Medium to low amounts (See Fig. 27) of medium to small coarse stones lay within or toward the edges of the four features.

(5) Variable amounts of chipped stone debitage. Features 5 and 6 occurred in areas of low to medium densities (zero to 4.5 g per ft^2) of chipped stone debitage. Features 4 and 7 were in areas of high density chipped stone debitage.

(6) Absence of chipped stone tools. Chipped stone tools or pieces of chipped stone tools were not common except in Feature 7. There also seems to have been an absence of stone tools in the general vicinity of Feature 5. Concentrations of chipped stone tools occurred to the southeast of Feature 6 and around the periphery of Feature 4. These included three complete and seven broken notched projectile points, four projectile preforms, two end scrapers, two perforators, two thin unifaces and two broken bifaces.

Distribution of Elements Within the Feature

In general the large pieces of bone were both resting upon and buried by carbonaceous-ashy matrix. Carbonaceous-ashy sand was encountered near the top of the features but spread out to its widest horizontal extent near the base. The largest pieces of coarse stones were at the edges. Large pieces of chipped stone debitage were scattered throughout Feature 4, but were absent from the others. My records do not show the distribution for the small stone flakes, only the average density for the excavation unit. Chipped stone tools were concentrated at the peripheries of two features and inside a third.

Relation to Other Features

Features 4 and 6 lay at the south and north edges, respectively, of Feature 9, a dwelling floor. A concentration of comminuted bone (Pulverized

Bones 2) and an overlapping scatter of larger bone pieces lay in the middle of Feature 9 between Features 4 and 6. Feature 5 was at the northeast edge of a second dwelling floor, Feature 11 (See Fig. 27).

Postulated Function

The four features seem to be refuse areas, two of which overlay hearths. Contents vary somewhat probably as a reflection of varied activities. Feature 4 (General Disposal Area) and 7 (Hearth-Disposal Area) contained the greatest amount and broadest spectrum of material. The matrix indicates ash and probably crushed charcoal and other disintegrated organic debritus. The condition of the bone suggests bone breaking (for marrow) and pulverizing (for bone grease). Whether or not the bones had been boiled for grease has not been determined, since a proven analytic technique for this type of observation is not known. Chipped stone debitage indicates both sharpening and new tool manufacture. The scant amount of coarse stone was discussed in Chapter V.

Discussion

There are few detailed descriptions of the distribution of bone refuse and other discarded materials around Indian campsites. When one stops to think about it, the shortage is logical. If one were asked to give a description of one's own household, the last thing one would think of describing would be what went into the garbage, how it was wrapped, and how it was piled in the back lane. So it is with early ethnographic observations. Descriptions consist of after-the-fact remarks or uninterpreted photographs. Nevertheless, one does not come away from the historical material emptyhanded.

There is confirmation of concentrations of bone that can be called bone refuse piles (See Appendix VI). The 'main' bone pile mentioned by Donaghy can actually be seen in the Fort Carlton photograph. One also gains an impression about how bones were scattered around camp both from Donaghy's comment and also from the Fort Carlton picture. While the main bone pile seems far away from the tents in the Fort Carlton photograph, a second smaller, but apparently similar pile can be seen at a position close to two abandoned tent floors. In addition, the Indian Tipi near Calgary photograph shows a collection of (clean) bones at the outside edge of the doorway to the tent. A second important feature is the presence of other objects beside bone in the refuse piles. One photograph indicates a black substance resembling decomposing organic matter among the bones and a small piece of hide (Fort Carlton piles), but this material does not appear to be present in the Calgary photograph in which bones are mixed with firewood. Herein lies a difference in function for the piles which could no doubt be amplified if observations could be made on small hidden objects in the historic piles. One could speculate that bone piles containing a large amount of decomposable matter should have been farther away from the living and work area than those without decomposable matter.

The modest concentrations of bone, for which the names bone pile and disposal area have been suggested in the light of historic observations seem credible. Historically, bone piles were thin spread-out affairs. Regrettably, comparative archaeological evidence does not add much, if any, information at this stage.

DWELLING FLOORS AND OUTDOOR ACTIVITY AREA

If there was a social division among a group of hunters into several small units, each occupying a discrete area in a campsite, then the divisions and areas occupied by each of the small units should be present in the archaeological record. Given sufficient trash and/or soil molds to make a pattern, and given good preservation, these should be identifiable. This hypothesis underlies the search for large area features in the Harder site. Soil mold refers to the impression of a feature or a configuration of impressions which can be interpreted as a feature. The well-known post molds outlining earth lodges of the Middle Missouri horticulturalists are an example (Lehmer 1971). Such soil molds have not been found at the Harder site, which leaves only trash for examination. Trash indicates several large areas of concentration and suggests the presence of at least one area amid the concentrations where there is an obvious absence of certain materials.

The main problem in interpreting these large area features is deciding how they may have been related to the activities of the smaller social units within the camp. The four most likely possibilities seem to be: (1) large features were composite activity areas inside dwellings (such as a hide tent); (2) they were composite activity areas outside dwellings; (3) they were garbage disposal areas (in the case of the concentrations); or (4) lightly occupied areas within the site (in the case of areas of low densities of remains).

Attributes of Large Area Features: Type 1 - Concentrations (Features 9, 11, 12 and 13).

Size

Length varies from a maximum of 13.4 m to a minimum of 5.25 m. There is insufficient information on width to give anything but an indication of the minimum which, in the two instances where we can see beyond the width of a single excavation unit, is at least 6.1 m. The thickness is the same as the occupation level. It is assumed that the thickness is not especially relevant as large features seem to rest upon the occupation surface of the site.

Shape

Apparently round; information incomplete.

Elements of the Features

(1) Roughly coincident concentrations of broken bones, comminuted bones, pieces of coarse stones, and carbonaceous-ashy soils.

(2) Small features including smudge pits, boiled bone disposal pile, bone refuse piles and hearth and disposal areas.

(3) Chipped stone debitage in variable amounts.

(4) Chipped stone tools present, and slightly more concentrated than in other parts of the site.

(5) Bone tools found only in these features.

Distribution of Elements Within the Feature

Medium to low concentrations of large broken and comminuted bone scattered throughout the features; concentrations of pulverized bones in association with medium densities of large broken bones occurred in the central areas of Features 9, 12 and 13, but not as much in Feature 11; coarse stone was scattered throughout with slight concentration just off centre; carbonaceous-ashy soils were spread throughout the feature with some intermingling yellow sand areas also in the feature; bone piles were at or near the edges of the features; smudge pits in the central area; boiled bone refuse pile off centre; medium, high and low density areas of chipping debitage all appeared within the features (no pattern evident in distribution); chipped stone tools scattered throughout the features (and beyond) with very slight concentration in central area; and bone tools in the central area.

Relation to Other Features

Insufficient information. The other features that large area features could be related to are each other. Since the excavation of each is partial, and even size and shape is only partly known, the best information that can be provided is a rough estimate of the distance between the type I features. It is estimated that they were about five to seven meters apart, from the edge of one to the edge of another.

Postulated Function

Living and/or working areas (1) inside or (2) outside a dwelling, or (3) garbage disposal areas.

Type II - An Unconcentrated Area Between Type I Features (Feature 10)

Size

Length (arbitrarily taken as the distance between Features 4 and 5) was approximately 7 m. Width was undefined but could be 7 m or more. Thickness was same as occupation level.

Shape

Insufficient information.

Elements of the Feature

(1) A noticeable lack of concentration of carbonaceous-ashy matrix, large broken bones, comminuted bones, and coarse stones. These elements were not completely absent, but were much reduced in comparison with other large area features.

(2) Dominance of yellow sand matrix.

(3) High, medium and low concentrations of chipped stone debitage.

(4) All large chipped stone bifaces found in the excavations, including an unusually large side-notched biface.

(5) A slight concentration of other chipped stone tools.

Distribution of Elements with the Feature

There was large dense concentration of chipped debitage in the west-central part of the feature, medium concentrations on either side north and south, and low concentrations toward the south edge and in the eastern part; a high concentration on the north edge was probably part of the chipped stone concentration in Feature 4. Large bifaces and other chipped stone tools were scattered with a slight tendency toward concentration in the central area of the feature.

Relation to Other Features

Feature 9 adjoins immediately north; Feature 4 adjoins immediately south.

Postulated Function

Living and/or working area (1) inside; or (2) outside a dwelling.

Relevant Ethnographic and Archaeological Observations

See Appendix VII for a review of ethnographic and archaeological observations relevant to the shapes and contents of dwelling floors and outdoor activity areas.

Discussion

The first proposal was that concentrations (Type I Large Area Features) were refuse disposal areas. By refuse disposal area, I mean a pile or concentration of materials representing remains of one or more activities; remains that have been transported out of an activity area(s) to a specific disposal area. A disposal area is created when an activity area becomes unworkable due to clutter or stench and users decide to clear up offending materials rather than move themselves to a new activity area. Such conditions might be due to rapid accumulation following intense use, or slow accumulation from less intense but repeated use over a period of time. The key questions, however, are 'What accumulation of material would Oxbow people tolerate in an activity area?' and 'How would they clear an activity area?' The answer to the first question is beyond present knowledge. The information at hand does not even clarify the situation for historic buffalo hunters. Consequently, it is not possible to distinguish between refuse areas and activity areas simply on the basis of amounts of remains. On the other hand, one can speculate how an area might have been cleared; and, more particularly, what to expect in a refuse area.

If an activity area was cleaned by picking up only larger pieces of waste, the refuse area should be comprised mainly of larger pieces of material. Smaller pieces such as comminuted bones, retouch flakes, and broken stone tools should be left at the site of the activity. The only feature resembling large-piece refuse areas at the Harder site were bone piles at the edges of the large area features. Another possibility is that all material, large and small, was cleared from the activity area. One method by which this process could be accomplished would be to have a large hide underlying the work area upon which detritus could collect. The hide could have been gathered up when it was full and carried to the refuse area for disposal of the waste. Ethnographically this method was followed for certain jobs such as bone breaking, berry pounding, and dried meat beating (See Leechman in Appendix V); but in these instances material in the hide was not waste, but produce. There is no ethnographic evidence that hunter-gatherers used a hide on the ground just to keep an activity area clean. Yet this had to be the case at the Harder site if large area features were special refuse areas because they contain many extremely tiny pieces of chipped stone, bone and coarse stone, which were not likely collected individually for disposal on a garbage pile. Therefore, the idea that large area features at the Harder site were special refuse disposal areas is dismissed.

Elimination of the refuse disposal hypothesis leaves the other option, that concentrations of materials were the actual scene of complex activities. Although there is some variation in amount of materials, all four concentrations had some carbonaceous-ashy soil indicative of the presence of fire and/or decomposed organic matter, some small chipped stone flakes indicative of stone tool manufacture or repair, some large and small broken bone indicative of marrow and grease preparation and some broken coarse stone. Whole and broken chipped stone tools also appear in each of the concentrations.

This combination of remains suggests that a complex of activities or a complex activity (rather than a single activity) took place within each of the large area features. Ethnographic observations suggest two places where such activities might have taken place: (1) inside a dwelling such as a common tipi, a chief's tipi, or a ceremonial tipi; (2) outside a dwelling either at an open-air cooking spot or in a partly-open sun and cooking shelter.

Ethnohistoric observations also indicate that the Plains Indian tipi was a general focus of camp activities year round. Several observers state or imply that all cooking was done inside the tipi. I think this emphasis must be clear before noting that, during warm weather, Plains Indians often moved cooking fires outside to open-air or to cooking shelters. During summer, cooking outside the tipi occurred about as frequently as modern patio barbeques. This idea is contrary to Kehoe's explanation for the lack of fireplaces in tipi rings (See Appendix VII). It is also contrary to my own experience on Indian reserves where outdoor summer cooking seemed extremely common, a situation which may be due to the difficulty of maintaining open smoky fires inside modern frame houses. Tipis, on the other hand, were well adapted to open fires and would be a probable location for a concentration of remains.

It has been noted that tipi (and other kinds of temporary movable dwellings) should leave extremely little structural evidence for their presence, except under rare conditions of preservation (See Appendix VII). In the case of tipi rings, while some evidence of the tipi was preserved, evidence for activities inside was usually not. Tipi rings do, however, draw attention to the range of basal circumference to be expected in buried sites as concentrations of material. Unfortunately, the diameter of a buried concentration may not be as accurate a measurement as a tipi ring due to probable spread of debris to a considerable distance beyond the circumference of the dwelling. Exposures at the Harder site suggest a range of sizes, including one feature larger than the common historic tipi but within the range of a large chief's tent, dancing tipi, or ceremonial structure.

One feature that should be recognizable on both a temporary dwelling floor and a cooking shelter floor, among other remains, is the fireplace. There was evidence for a fireplace at the Harder site in one small isolated exposure (Feature 3). The other dwelling floors also bear evidence of fire in the form of burnt comminuted bone and carbonaceous-ashy soil sometimes vaguely concentrated as, for example, in Features 6 and 7. But aside from Feature 3, distinct fireplaces evaded excavations.

Complex II at Kostenki XIX (See Appendix VII) provides a close dwelling floor analogy for the Harder site large area concentrations. Complex II was a concentration some 3 to 4 m in diameter of carbonaceous-ashy soil, broken stone, and broken bone bounded by a circle of upright wooden posts and mammoth bones. In the centre of the concentration were several patches of burnt red loam. The patches of red loam were interpreted as bases of fireplaces; the upright posts and mammoth bones as supports for a temporary dwelling; and the concentrations of other material in the middle as the dwelling floor. I disagree with a similar interpretation for Complex I which lacks the closely associated broken bone, stone, and post holes, but possesses a very clear fireplace between two post holes. Complex I instead appears to be an open-air cooking area associated with a nearby habitation. Features comparable to Complex I were not seen at the Harder site.

The Larter site (See Appendix VII) revealed a concentration of material similar to the Harder site and a central fireplace identified as a roasting pit. The whole concentration was interpreted as a place where a buffalo was butchered, an interpretation which seems sound. Since the site was situated in clay, evidence of a dwelling such as a row of peg molds in a circular formation around the perimeter of the concentration might have been preserved. Such evidence was not noted, possibly because the excavation technique required by the sticky clay did not reveal such features. In any case, the Larger site excavation shows the central position of the fire in a concentration of occupation debris.

In the light of comparative evidence, my guess that large concentrations at the Harder site were the floors of temporary dwellings. If areas of concentration were habitation areas, then areas such as LAF Type II, lacking most materials other than stone chips and chipped stone bifaces, must have been open spaces between habitation structures, used occasionally for laying out and cutting something or for resharpening stone tools.

In conclusion, the following individual interpretations for the large area features are offered. Feature 9 was the floor of a large habitation structure, possibly a skin tent. It extended from Feature 6 to Feature 4, a distance of 6.1 m. Features 4 and 6 were refuse areas near or on the edges of this dwelling. Feature 4, being largest and containing the greatest amount and variety of remains, was probably a general refuse area at the edge of the doorway. Feature 6 looks like a short term hearth and bone disposal area at the back of the dwelling or possibly on the edge of it beneath a partly rolled up wall. There was a concentration of grey-black (ashy) soil, broken, comminuted and burned bone, and gritty stone in the middle of the dwelling floor. This feature may correspond to a central hearth. If a circular perimeter was assumed and extrapolated into the adjoining areas, the floor plan of the dwelling would be as shown in Fig. 27.

Feature 10 was a space between dwellings, perhaps utilized at one time as a work area. Broken bifaces were left in this area, perhaps having been used in cutting or chipping activities. Stone chipping also took place here.

Feature 11 was probably part of a dwelling floor.

Feature 12 was a complex comprised of a dwelling floor and at least two ouside features including a smudge pit (Feature 1) and a boiled bone spill pile (Feature 8). The clear semicircular distribution of broken and comminuted bone and especially the carbonaceous-ashy matrix in excavation units 42e10s and 42e5s is taken as an indication of the perimeter of the dwelling.

Feature 13 contained a hearth and smudge pit and is believed to have been the central area of another dwelling floor.

SUMMARY AND CONCLUSIONS

In summarizing the results of this dissertation it would seem that the principal aim of the study, the investigation of a single component site and interpretation of the contents in terms of activities within a focal subsistence-settlement system, has been accomplished. By posing fundamental questions, what? where? when? who? why? of each part of the remains, a detailed conception of Harder site activities has been formulated.

What? The Harder site was comprised of six to eight dwelling floors, strewn stone tools and a few bone tools, with pulverized bison bones, with small fragments of cooking rocks, and silhouetted by black-brown soil residues. A number of structures with a generally round floor plan, such as hide or bark tipis, or hide or brush-covered wickiups, could have been used. Evidence for the exact kind of dwelling was not discovered, and a lack of structural remains is predictable with the use of temporary dwellings common among hunter-gatherer groups. The possibility that the activity areas were not covered but open to the elements was considered but then dismissed in view of the activities represented.

One of the foremost activities was breaking bones, particularly limb bones as few other parts of bison were represented at this site. Limb bones, rich in marrow and grease, were broken in order to extract the marrow from large internal cavities and then boiled to obtain the internal grease. Presumably, bone breaking was part of preservation/consumption of freshly killed bison. During the historic period, Plains Indians undertook such activities in the kill-butchering area, in a specialized processing area nearby,-or, on a less intense scale, inside the tipi back in camp. The high degree of breakage, the very selective representation, and the small overall volume of bone suggests the campsite interpretation is best at the Harder site.

Coarse stones were apparently also part of the bison preservation/consumption process representing in a small degree hammers and anvils for bone breaking, and to a much larger degree representing cooking stones for roasting meat and boiling bone fragments for grease. The smallness of coarse stone fragments suggests both intense use and selective removal of certain larger pieces upon abandonment of the site.

Chipped stone tools, with projectile points and end scrapers dominating the collection, suggest several other activities. Careful analysis shows that the projectile points were worn out, broken and unfinished discards, indicating that extensive repairs to projectiles were undertaken at this location. Chipping debris supports this interpretation. The new or repaired projectiles were not found at the site, but the stone detritus from their manufacture and the pieces they were meant to replace were abundant. End scrapers were similarly a worn out and discarded lot, apparently used intensively and then disposed of in the same site. Removal of flesh from the inside of buffalo hides is the kind of activity probably reflected by end scrapers.

Small numbers of other kinds of tools indicate that other kinds of activities also occurred but were not so intensive. Included were precision cutting (slitting hides, and sinews, for example) represented by thin uniface knives; perforating of soft materials (such as hides) represented by perforators; and a small amount cutting-chopping (of buffalo flesh, for example) represented by large bifaces and bifacial thinning flakes. The multiple use of each activity area would seem a more likely possibility in a camp than in a kill-butchering or specialized processing area. The sparseness of large bifaces, of large bifacial thinnin flakes and of 'utilized flakes' indicative of butchering is also what might be expected in a camp situation. In a camp, the circumstance that would best explain how such a variety of activities tended to be both intermingled and be clustered is that they took place inside the confines of a dwelling.

Certain phases of these activities have been distinquished in features both inside and outside the dwelling floors. One example is disposal of boiled bone fragments represented by a boiled bone spill pile outside one of the floors. Another example is hide smoking indicated by two smudge pits, one of which was certainly within a dwelling floor. Yet another is disposal of large bone fragments in piles at the edges of dwellings. One clear hearth was discovered, inside a dwelling; several disturbed hearths are indicated on the other dwelling floors by concentrations of ashy-soil, fire-cracked rocks and charred bones.

Where? Topographically, the Harder site was situated in a dune depression at the north edge of the Dunfermline Sand Hills, some 20 km away from the nearest stream. From the long profiles through the site it appears that the depression was established before the Oxbow occupation. Furthermore, regional palynological studies, soils studies, and, indeed, the collection of animal bones present at the site suggest that the parkland vegetation presently surrounding the site has been stable for several thousand years including the time of occupation. Consequently, the Harder site was situated in an edge area, within a rolling and presumably wooded area which provided broken terrain for animal traps, and wood for fuel, building materials, and shelter. Yet the site was also very near an open grassland which could have pastured large herds of bison. One and perhaps several kill sites associated with the Harder site must be nearby. One possible candidate for such an associated kill site has been located in a dune depression 200 m to the southwest. In regard to the total distribution of known Oxbow sites, the Harder site lies somewhat north of centre.

When? The Harder site was occupied approximately 3400 years ago, at a time when the Oxbow complex was already almost two thousand years old. The Oxbow complex survived at least 300 years past the time of the Harder site making it one of the most stable and long-lived technological traditions in North America. In regard to length of occupation, calculation of the time required by a camp this size to consume one half the buffalo represented by bones while preserving the other half indicate that a minimum of 21 to 42 days would have been required for these activities.

Season of occupation is not easily determined since the analysis of bison ages could not be performed due to a lack of mandibles. If the focal model is correct the large number of bison found in the Harder site could have been killed during any season with the possible exceptions of springtime and perhaps late summer. The absence of water in the site locale, however, with fresh water being at least 20 km away and the closest seasonal slough 2 km distant, would seem to provide some constraint on the season such a camp could be maintained. Unless the occupants were willing to carry water at least 2 km or dig a well several meters deep, the only time the site could have been occupied was when snow was present as a water supply.

Who? The technological-stylistic identity was recognized early to be that of the Oxbow complex. The question then became what sort of society did the Oxbow complex represent,and more particularly, what part of the Oxbow society did the Harder site represent. The remains are those of a society at the hunter-gatherer level, and with the predominance of bison bones in all known Oxbow sites, a band society with a specialized economy focused on bison hunting would seem the most likely possibility. It has been noted (Birdsell 1968:234) that in band societies with specialized adaptation on concentrated food resources such as bison herds, the society is most of the time divided into local groups averaging 50 to 100 persons. The estimated 42 to 56 individuals occupying the Harder site falls into this range and would, therefore, seem to be a typical local group of a specialized (focal model) band society.

Why? One question is why this location? The answer is that the Harder site offered close proximity to grassland pasturage and bison herds, while at the same time providing shelter, wood for fuel and building materials (for a pound enclosure for example), and rolling topography ideal for communal pounds and surrounds. Such factors would have been of primary importance to the bison hunters who occupied the site. The question why were only certain kinds of bison bones at the site, is best answered by referring to butchering/processing practices. So-called marrow bones were often taken away from the kill site for processing and consumption, while the remainder were left at the kill site. The predominance of marrow-bones in the Harder site is then readily explained when it is known that the Harder site was a campsite.

The preference for bison over other animals seen not only at the Harder site but in all other Oxbow sites can be explained in economic-ecological terms. Bison were both the most numerous of the big-game prairie-parkland animals, and also the heaviest. In consequence of these facts, bison were the best game species in the area.

Finally, the question might be asked, why were so many tools left at this site? The answer to this question lies in the condition of the tools. The tools found at the Harder site were in one of three stages; namely, broken, worn out, and unfinished. The number of complete functional tools was very small if, indeed, there were any among the collection. The simple answer is that the tools were discarded.

With the growth of settlement archaeology during the past decade, has come an interest in investigating whole components in order to determine the range and distribution of materials within sites, and on a larger scale, differences between sites. The importance of knowing the 'whole' site will increase in the future, but funds and time for total excavations will probably not keep pace. In place of total excavations future archaeologists may have to rely on complex sampling strategies. At the Harder site, mechanically excavated trenches were used to explore the limits of the site and, to a limited extent, to determine the internal distribution of material. At the same time broad hand excavated transects were run across the site in order to locate features, expose enough area to allow the identification of features, and to show the spatial relationships between one feature and another. It would now be interesting to attempt total excavation of the Harder site to see how accurately the approximately 10% sample collected in this fashion actually represented the whole site.

Great strides have been made in studies of seasonality in bison kill sites. It is now possible by examining the states of tooth eruption and wear to determine the season of occupation within a month or so. Unfortunately, this method cannot be performed on a site that lacks mandibles, but with more basic research, the study of the biannual growth rings in individual teeth may allow determination of seasonality with equal accuracy. In the meantime identification of a winter occupation at the Harder site rests on the lack of any nearby water source excepting winter snow. Other lines of evidence bearing on seasonality need to be developed.

Buffalo kill sites, are the best known archaeological manifestations in the Northern Plains. There is no doubt about the importance of kill sites to an understanding of Plains Indian subsistence and settlement. However, ethnographic evidence indicates that the greatest part of Indian life was spent in campsites and, in the future, a much larger proportion of archaeological interpretations will probably come from these kinds of sites. Single component sites with relatively straightforward stratigraphy should provide the optimum situation for campsite investigations within a subsistence-settlement framework.

At the beginning of such a study, however, it becomes apparent that models for features, for tool use, and for camp layout are not readily available. Underlying this dissertation has been the idea that models must be developed for patterns found in campsites. An obvious source of models is the ethnographic-historic literature about Plains Indians and that source has been used extensively for the feature interpretation at the Harder site. Models need not be limited to Plains Indian sources, as ethnographic and even archaeological analogies for other places may be relevant as shown by the Kostenki site material. And when no relevant analogy can be found, then the archaeologist must create his own models as was done with tool functions and life stages of tools at the Harder site. Modelling is perhaps the most productive exercise in archaeology.

The Harder site, in conclusion, offers an introduction to the Oxbow subsistence-settlement system. In the site we see the remains of a major phase of the annual cycle, namely, the winter camp of a local group of bison hunters. The kinds of tools are not numerous, (this was predicted by the focal model) but large numbers of certain kinds were present indicating intensive use. No doubt most of the same kinds of tools, plus a few others, will be found in other Oxbow settlement types. What will be obviously different at some sites, however, will be the life stages of tools within the same classes. At sites where tools were discarded, there will be a great similarity to those at the Harder site, but at other sites where tools were lost (such as projectile points at kill sites) the shapes may be somewhat different reflecting a 'younger' life stage of the same classes of tools. The Harder site is clearly a part of a group of systems in a larger universe, systems of tools, features and settlements. If the basic features of a temporary campsite can be determined, there is hope that each of the other parts can be known too.

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APPENDIX 1

DISTRIBUTION OF BONES IN THE HARDER SITE

WHOLE BONES AND LARGE BONE FRAGMENTS

Bones were well scattered throughout the site. Whole bones were very rare, and no bones or fragments were articulated as if a limb or some other region of an animal had been left intact. During excavation I recognized three piles of larger bones and had a general notion of there being somewhat more bones in certain areas and somewhat less in others. However, accidental covariation of the density of bone with the sequence of excavation made the broader differences seem less than they really were. For example, the greatest variation in bone density occurred between excavation units 0w25s and 0w20s, a fact not noticed in the field because the units were excavated two years apart.

Small Concentrations

A bone feature labelled Bone Pile 1 appeared about the centre of unit 0w5n. It was approximately 92 cm long by 61 cm wide and was roughly oval in outline (see Plate 11). The feature was first encountered trowelling down into the Oxbow component, and it disappeared as the living floor was passed through. Bone Pile 1 was about 7 or 8 cm thick. It was composed of buffalo bones including individual teeth, two femoral heads, a metacarpal, a rib head, two distal ends of tibias, fibular and tibial tarsals, and phalanges; and was one of two areas in the site where Canis bones were clustered, representing, in highly fractured form, the right mandibles of two large canids. A denser than usual concentration of comminuted bone occurred more or less above the Bone Pile 1 and intermingled with it. A few large gritty rocks accompanied the bones, and a grey-black carbonaceous-ashy sand was the matrix surrounding the bones.

A second bone feature (Bone Pile 11) was discovered straddling the south border of unit 0w45s. (see Plate 12). It was approximately 46 cm in diameter and roughly circular in outline (see Plate 13). Bone Pile 11 was approximately 8 to 10 cm in thickness; and, like Bone Pile 1, seemed at the same level as the main occupation floor. Only _Bison_ bones were present in this feature: included were individual teeth, an atlas and two other cervical vertebrae, the distal end of a humerus, and several carpals, tarsals, and phalanges, and the proximal end of a metatarsal. Some bones had been thoroughly split apart _in situ_ by frost action, but other than that, little comminuted bone was associated. There was no gritty stone, and black-grey sand occurred in about 75% of Bone Pile 11.

The third and largest bone pile occupied all of unit 0w20s. The exact shape is not known since the eastern part of it (probably a small part) was sliced off when the ditch was cut, and since the western part is still buried. The north and south borders show that the pile was elongated from northwest to south east. Extrapolating from the part seen, I estimate that Bone Pile 111 occupied most of an oval area with dimensions about 3 m by 2 m. The bone pile began at a depth of 31 cm and ended at a depth of 46 cm, giving it the height of about two layers of large broken bones. Like the other bone piles its base was level with the occupation floor. The bison bones in it included individual teeth and a couple of other skull parts, a cervical vertebra (gnawed), a rib head and a mid-segment, a segment of scapula, three pieces of humeri, five pieces of radii, four carpals, two distal ends of metacarpals, pieces of left and right acetabula, four distal ends of tibias, eight tarsals, one third and two second phalanges, and six phalangeal sesamoids -- a good cross section of the Bison remains in the site. Six small unidentified bones together with a fairly large amount of comminuted bone were intermingled with the larger pieces. A few gritty rocks were scattered through the bones. The soil matrix consisted of a mottled mixture of yellow and black-grey carbonaceous ashy sand as did the other two bone piles.

Large Concentrations

It was anticipated that during preparation of composite planviews for the whole site, patterns which were invisible during excavation would suddenly pop out. This did not happen , but the results have raised new questions. What would a large composite feature correspond to? A family living unit? A specialized activity area? A garbage dump? Does a concentration of material collect at, and therefore represent, the centre of an activity area or its periphery? How does one delineate large features if, in fact, they are detectable? The method I adopted was two-pronged, first, each material component in the site was mapped and examined separately to see if there were separate patterns. Then each component was compared to the others to find similarities and differences. Covariation in two or more components sparked the recognition of a large feature. Second, ethnographic and historical records were searched to locate detailed analogies for models. Fig. AI.1 provides a composite planview of whole bones and

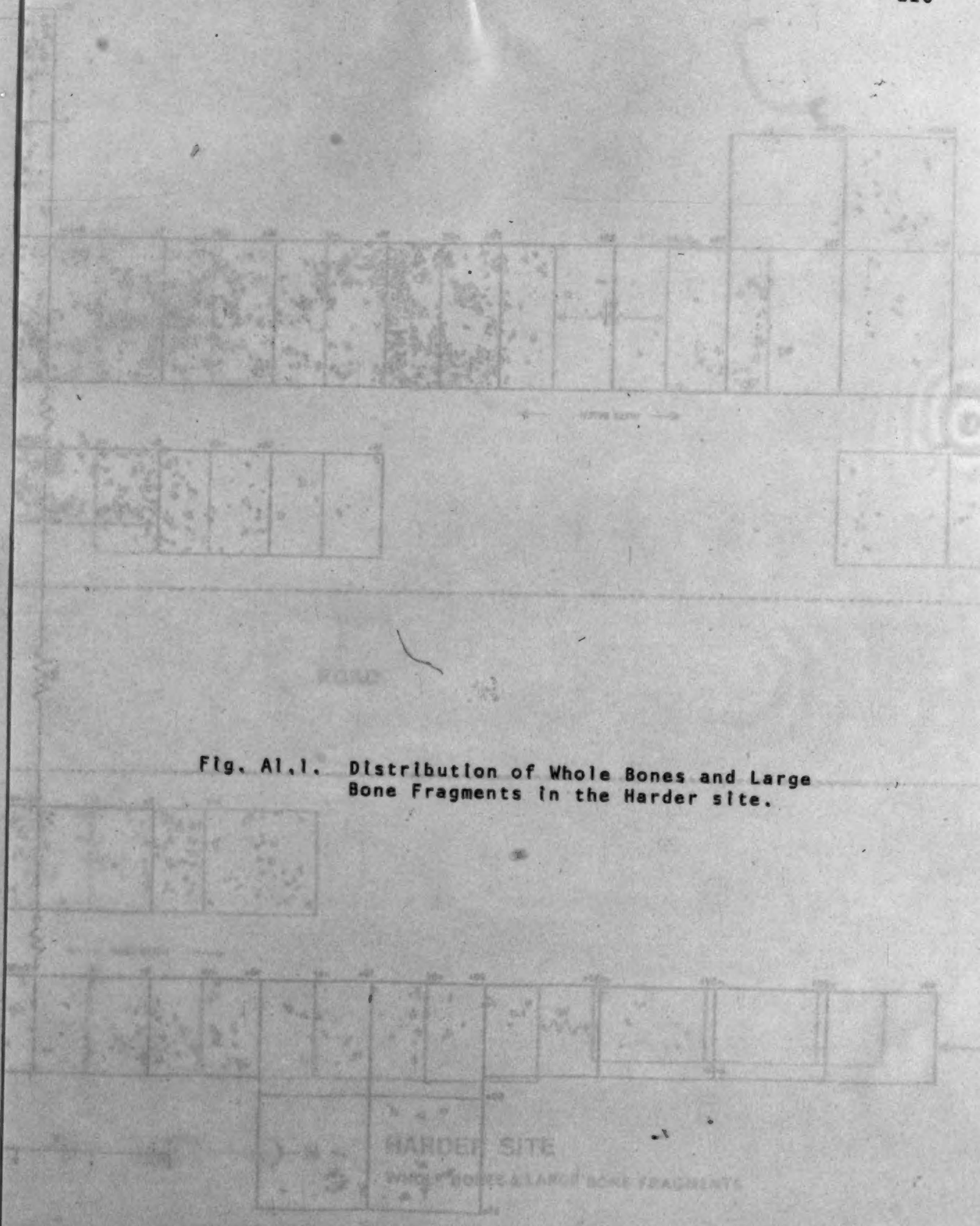
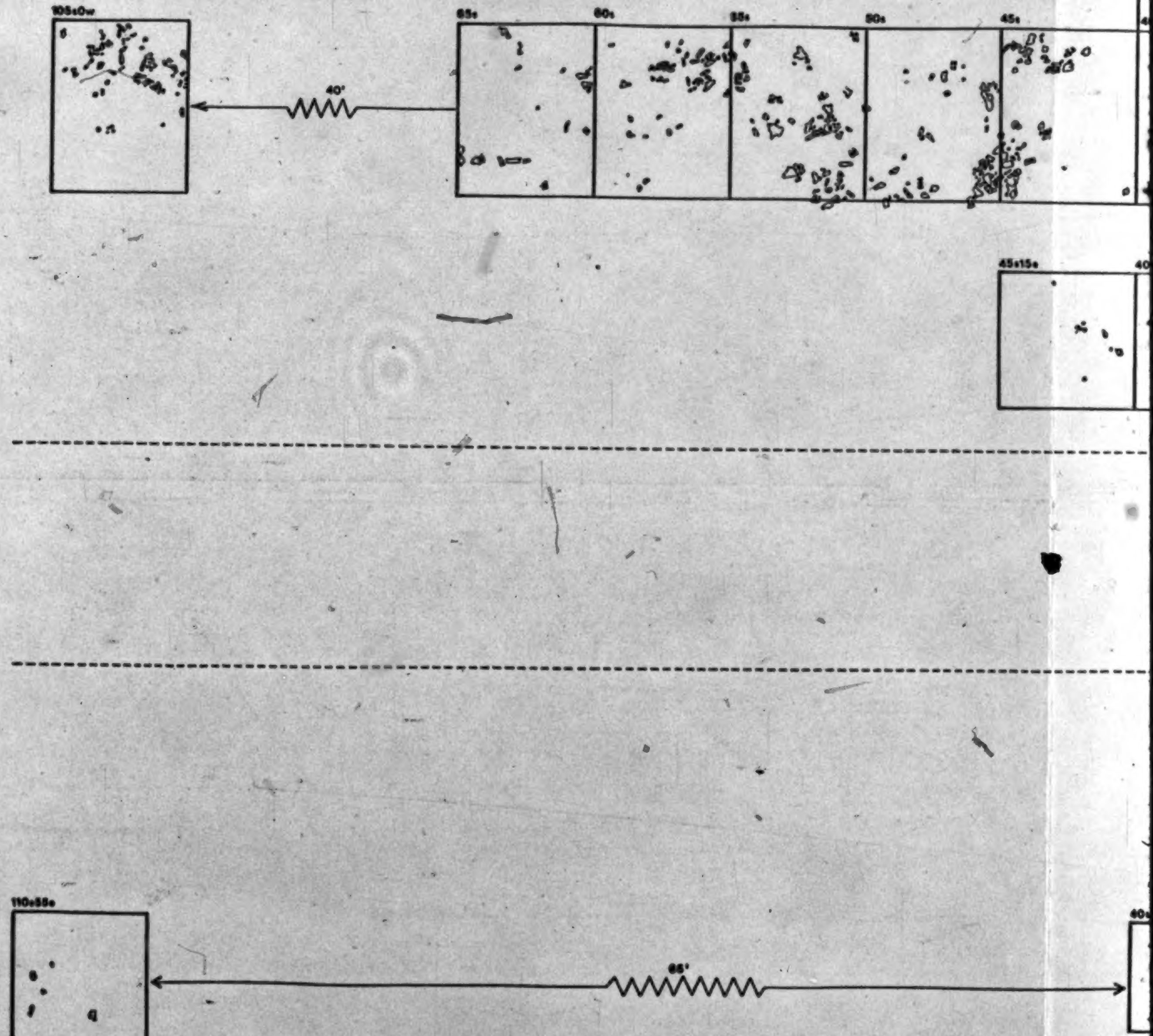

ROAD
HARDER SITE
WHOLE BONES & LARGE BONE FRAGMENTS

Fig. A1.1. Distribution of Whole Bones and Large Bone Fragments in the Harder site.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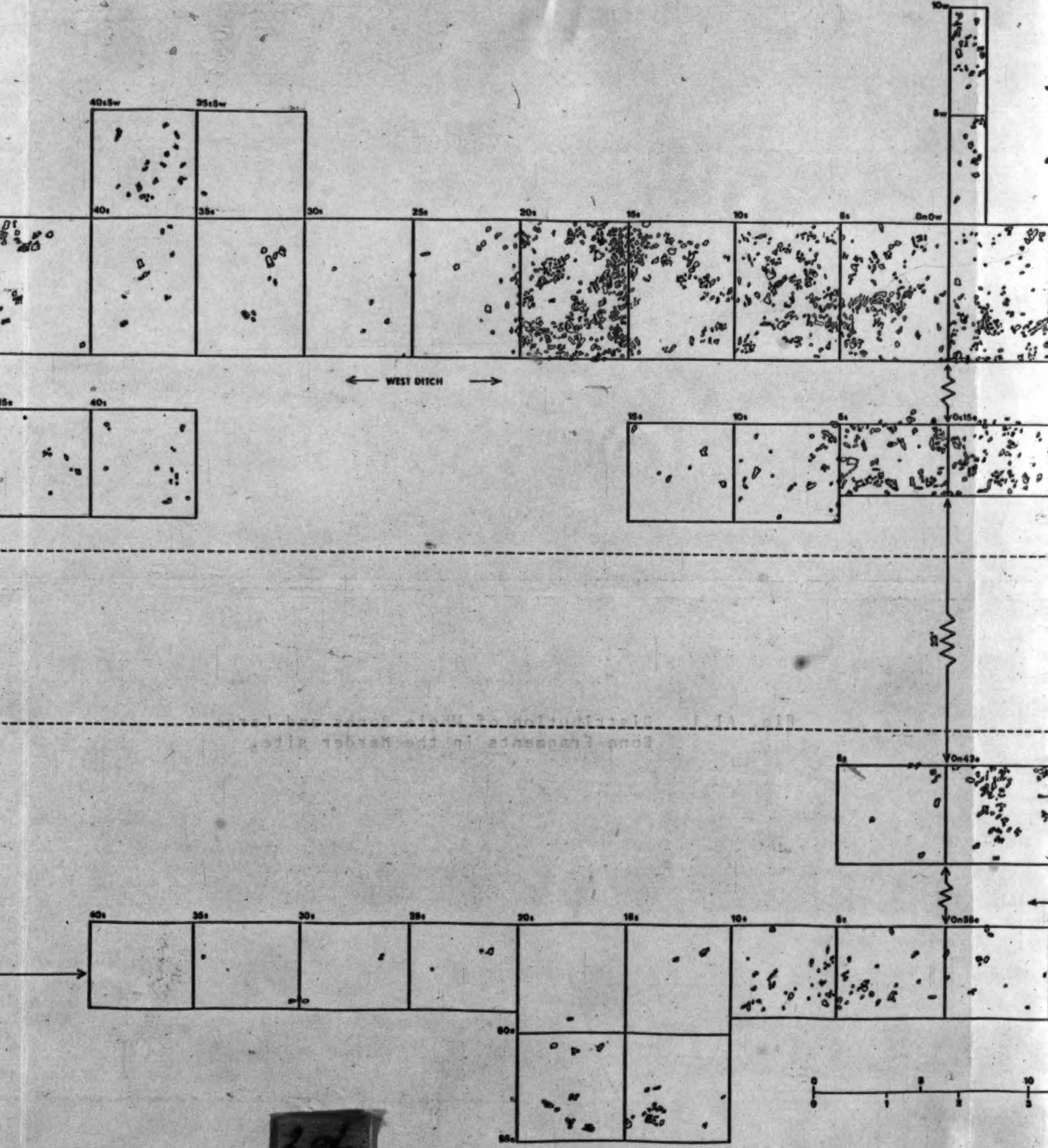
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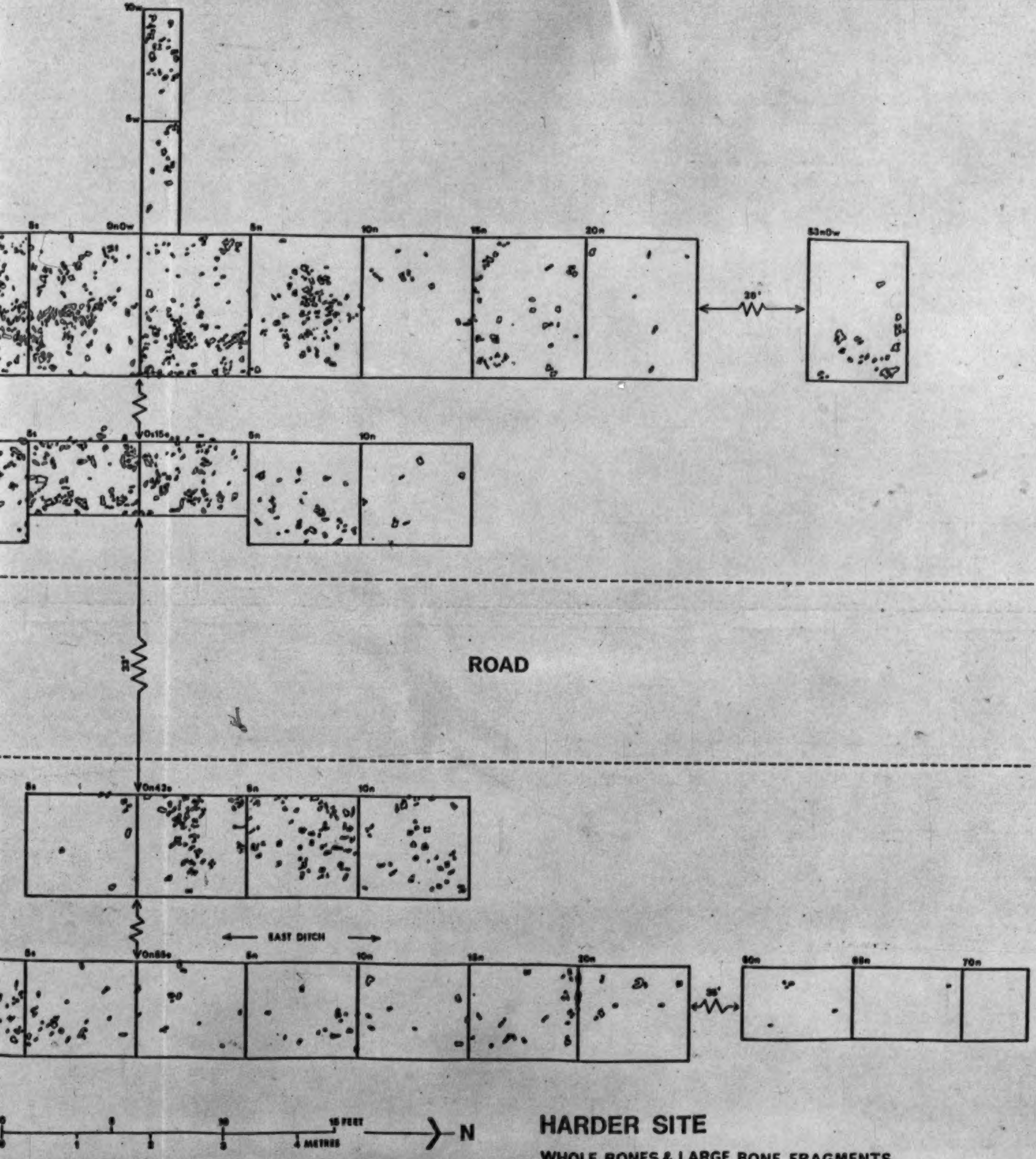
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HARDER SITE

WHOLE BONES & LARGE BONE FRAGMENTS

large bone fragments in controlled excavation units.

Large Feature 1. The most obvious large concentration of bones began on the south with Bone Pile 111 and was scattered northward with the limit at about Bone Pile 1. This feature probably extended eastward to include bones in units 15e, 10n-10s, and westward it probably spilled into the unexcavated area covered by 5-10w, 0-20s.

Large Feature 11. The next most obvious concentration began with Bone Pile 11 and extended southward about 5.25m to about the middle of unit 0w65s.

Large Feature 111. This area was marked by a near absence of bones. On the north border was Bone Pile 111; and on the south, Bone Pile 11. Excavation units to the east and west sides showed a very low density of bone.

Large Feature 1V. The scattered bones in units 10s - 20n on the 55e line and somewhat denser amounts from 5s - 15n on the 42e line indicated the presence of another large feature. The limits become clearer in the light of the distribution of comminuted bone materials.

Large Feature V. The lone unit 0w105s, some 10.5 m south of the main excavations, was part of a large composite feature. The concentration of material was not clear for large bone but it was clear for small fragments. By examining the ditch profile, material was seen to extend about 2 m north and 2 m south of the excavated unit.

Other Possibilities

Outlying excavation units such as 55e110s, 55e60n, and 0w53n all produced a trace of large bones, but lacked other material suggesting they were not parts of large bone features. One other concentration, however, may be the edge of another large feature. Bone in the eastern halves of units 15s60e and 20s60e may fit onto the western edge of a concentration of material at the west end of the east trench, which began 1.5 m beyond the units in question. Outside controlled excavations, north and south ditch profiles and east and west trenches produced one more concentration of large bones intermingled with other materials located in the west trench between 14w and 32w. This bone could be a separate large feature just west of Large Feature 1, or an extension of Large Feature 1.

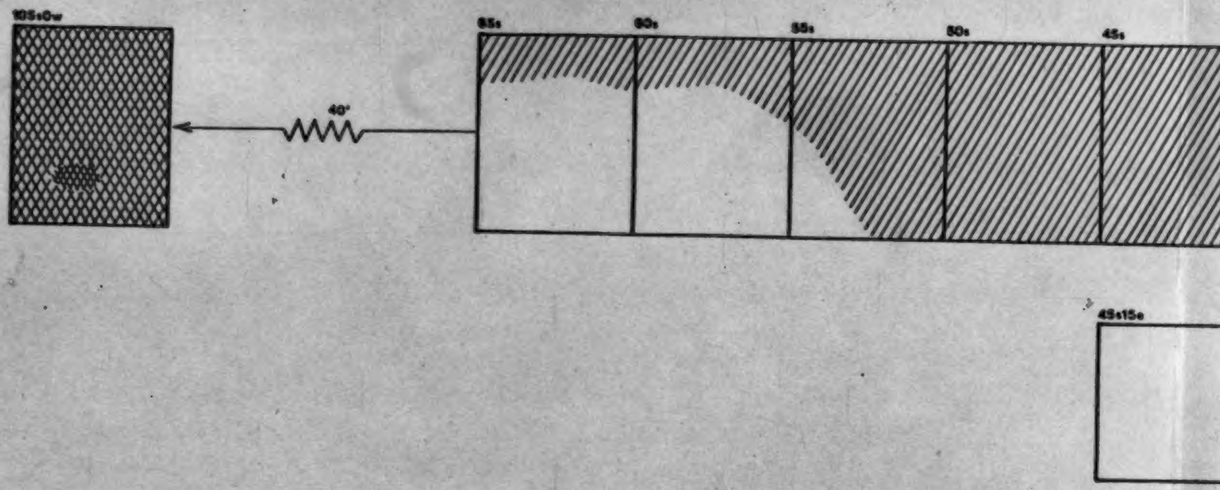
Two miscellaneous observations conclude the description of large bones. In regard to the distribution of species, Large Feature 11 contained fairly great diversity of species although it is the smallest of large features. About one half the Canis bones, all Lepus and Martes, several small unidentified bones and the usual Bison appeared in this area. Large Feature 1 contained about 30% of the Canid bones (most teeth being in Bone Pile 1), the single Alces specimen, and two human teeth in addition to Bison. Large Feature 1V had most of the remaining Canis, or Vulpes and most of the small unidentified bones as well as Bison. Thus, three large features account for nearly all of the non-Bison remains, the few leftovers being widely scattered. Secondly, the only instance in which more than two elements fitted together to make a part of a limb occurred in units 5w40s and 5w35s part of large (open) Feature 111. Two third, two second, and two first phalanges, and the distal end of a left metatarsal, comprising almost all the bones in the units could be re-articulated into one complete left rear foot which may indicate that metatarsals were broken open with the phalanges still attached.

DISTRIBUTION OF COMMINUTED BONE

Comminuted bone consisted of unidentifiable segments of bone, which were grouped into three sizes to show the degree of breakage: (1) 0.5 - 2.5 cm, approximately 45% of the comminuted bone; (2) 2.5 - 5 cm, about 35%; and (3) 5 - 13 cm, about 20% (by volume). Most large segments and a few of the smaller ones were individually mapped on excavation plan views, and are shown in Fig. AI.1. That figure however shows only about 50%, or a little less than one half by weight of the total bone remains from excavations. Over half the total weight of bones was in the form of little segments 5 cm. and smaller in length. Because the site contained not tons of bones, but a few hundred weights, I saved everything that turned up in the screens. During excavations it was apparent that many bones would only be identified if they could be partly reconstructed. Fitting and glueing paid off with a dozen or so identifications which otherwise would not have been precise. More important though, as excavations continued and clear cut pits, hearths, and bone breaking stations were not appearing, I began to believe that the broad distribution and density of comminuted bone held information of considerable value.

Fig. AI.2 maps the density of comminuted bone, calculated in grams per square foot, over the surface exposed by excavations. Comminuted bone includes segments broken to their present size by original inhabitants and segments broken in situ presumably by frost action. The inclusion of frost-broken segments raises the percentage of pieces in the smaller categories but has no affect on the density map. Variation in the colour of the segments was noticable. About 50% were buff-coloured, apparently unaltered by exposure to weather,

Fig. A1.2. Distribution of Comminuted Bone in the Harder site.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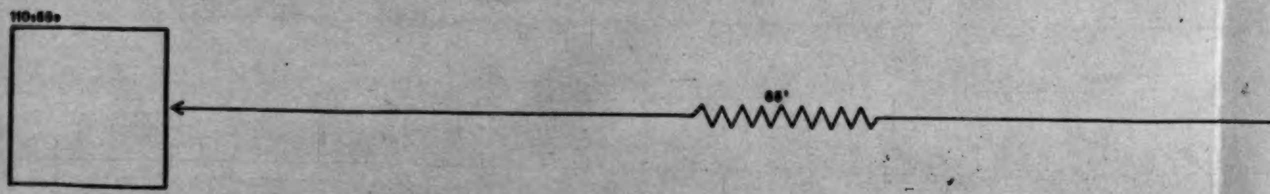
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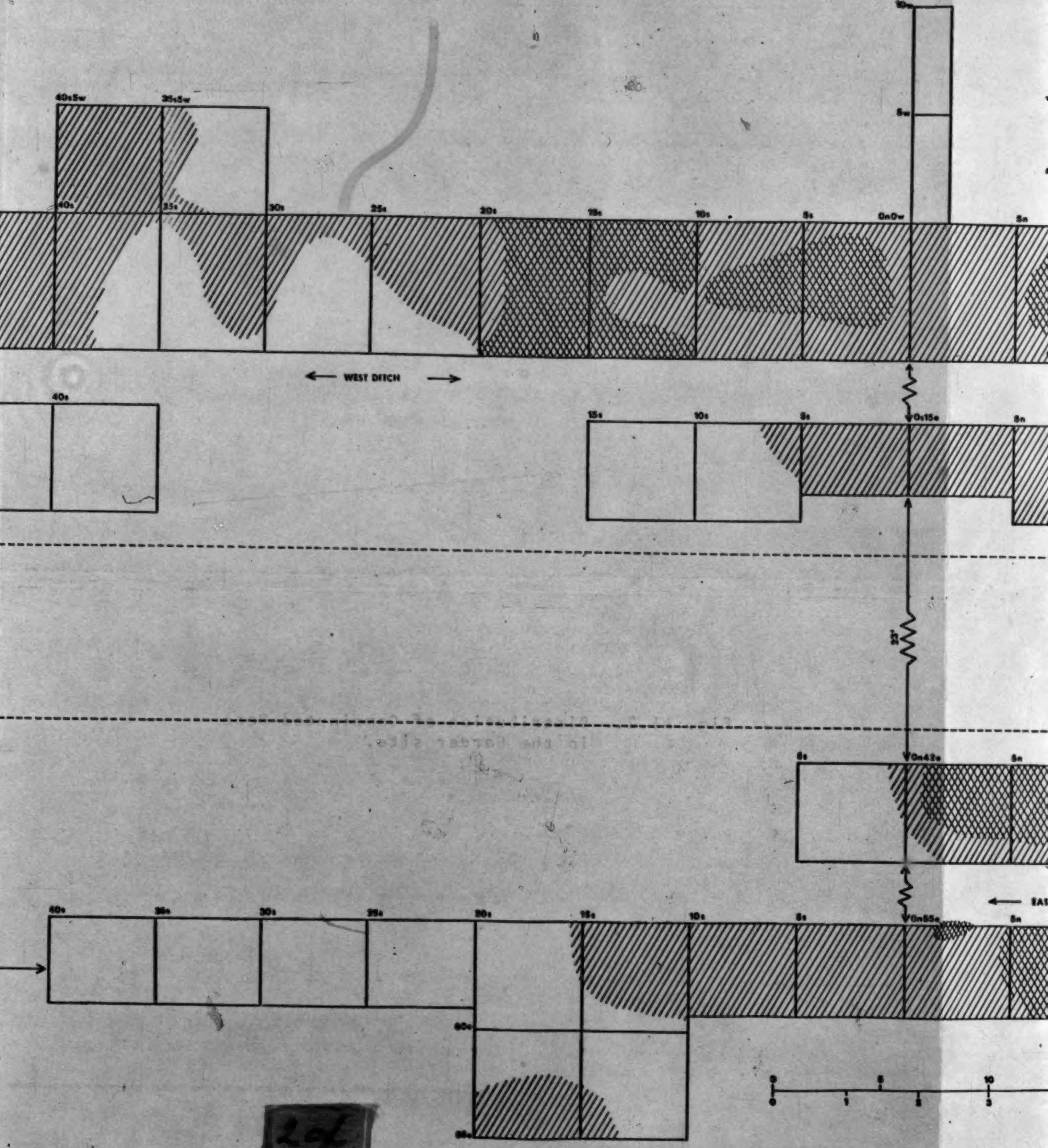
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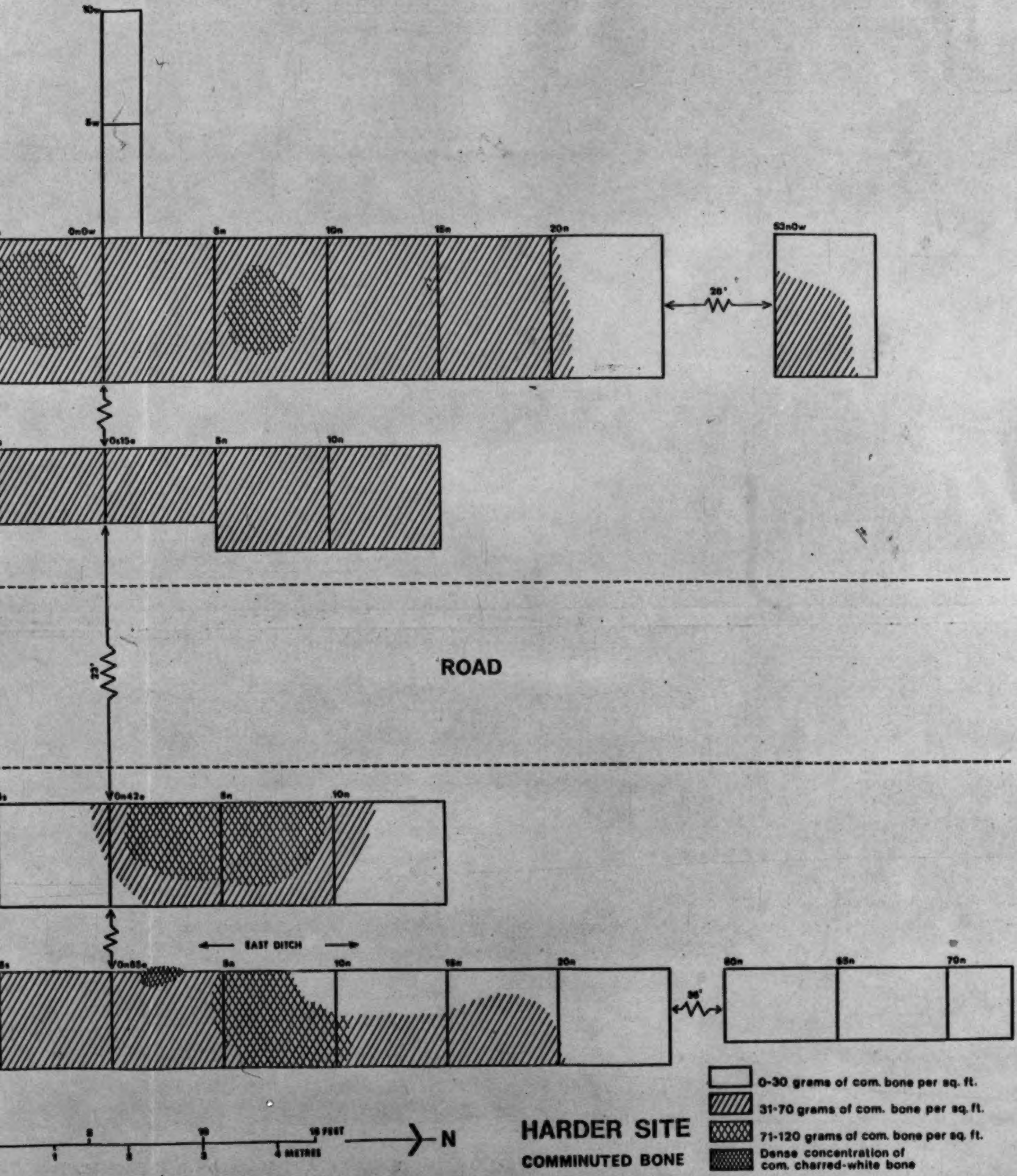
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0-30 grams of com. bone per sq. ft.
31-70 grams of com. bone per sq. ft.
71-120 grams of com. bone per sq. ft.
Dense concentration of com. charred-white bone

HARDER SITE

COMMINUTED BONE

by organic stains from flesh , by soil chemicals, or by fire. About 30% were mainly buff-coloured but with some part of their surface mottled grey-black, or dark brown-orange. The mottle occurred sometimes on the inside, sometimes the outside and often on both surfaces at once. The same mottle was observed in about the same proportion on larger bones. Charred segments of two types made up the 20% balance. Black-grey charring over all surfaces was observed on approximately 15%; white-blue charring over all surfaces on 5%. Charred pieces, with very few exceptions, were the smallest in size. White-blue segments were concentrated in two places, but otherwise all four colour types seemed to be mixed wherever comminuted bone was found.

The densities shown on Fig. A1.2 were calculated by weighing all unidentifiable comminuted bone in a particular unit and dividing by the number of 30 cm (1 ft) squares in the unit. The statistical result was the average weight (in grams) per 30 cm square for that unit. The average density for each unit was calculated by this method, and the range of densities produced was divided into three mutually exclusive classes which could be depicted by separate symbols on the map. The distribution of bone within each unit was based on (1) memory of first hand experience, (2) colour slides of each unit which to some extent show the individual small segments, (3) the general observation that comminuted bone seemed very often to coincide with grey-black sand which can be seen clearly in the slides; and (4) written notes on field planviews indicating the denser concentrations. Results were as follows.

Small Concentrations

The densest concentrations of communited bones occupied fairly well defined areas of medium to small size. Both medium and small concentrations are described here under the same heading.

A comminuted bone feature named Pulverized Bones 1 was located near the centre of Ow5n. It was approximately 107 cm by 76 cm in horizontal extent, and was roughly oval. By far the greatest density of segments lay at about the level of rest of the occupation floor, which in this unit was 48 cm below the present surface. Considerable amounts of segments were encountered in the top 6 cm of the occupation level and continued 2 or 3 cm below giving, a depth of approximately 9 cm to this feature. Pulverized Bones 1 occupied essentially the same space as Bone Pile 1.

Pulverized Bones 11 lay in the centre of units Ow5 & 10s, had horizontal dimensions of 2.7 m by 1.3 m and had the shape of an elongated teardrop broad end north. Unlike Pulverized Bones 1, the vertical concentration of this feature showed it to be a little top heavy. The greatest concentration appeared in the uppermost part about 41 cm below the present surface, decreasing only slightly to a depth of 45 cm, then dropping off rapidly until only a trace remained at 47 cm. Pulverized Bones 11 seemed to be level with the surface of the occupation floor.

Pulverized Bones 111 extended beyond the limits of excavations, so its shape and size are unknown. It occupied most of units Ow15s and Ow20s in much the same space as Bone Pile 111. During excavations, bone segments began to appear at 34 cm below the present surface. Gradually they increased in density to a depth of 43 cm, when they decreased rapidly and continued to decrease to about 46 cm, when they increased again to a greater density than before. The second concentration continued to 54 cm, then dimished to a trace which we followed to 62 cm where the bone segments petered out. It seems that in this feature there were two layers of comminuted bone, with one resting about the usual level of the occupation floor and one below it.

Pulverized Bones IV lay mainly in 55e5n , spilling slightly into 55e0n and 55e10n, and extending both westward into the space disturbed by the ditch and eastward into unexcavated territory. Its dimensions were about 2.1 m (7 ft) by 1.3, (4 1/4 ft) and its shape was oblong. The material was in a layer, no doubt part of the Oxbow occupation but impossible to locate relative to an occupation floor because there was almost no associated material and the matrix was a pale yellow-brown sand the same as that above and below the Oxbow components. Thickness of the layer was about 8-10 cm.

Pulverized Bones V was situated in units 42e0n and 42e5n. Its horizontal dimensions were 2.7 m by 1.2 m. In the field, this semicircular feature was evident at a glance. It appears likely that the mirror image of it could be found immediately west under the road. The segments were evenly spread through a layer about 8 cm thick. Again, the concentration of comminuted bone was resting at about the floor level of the component.

Pulverized Bones VI was partly revealed in 0w105s. The concentration spread in all directions beyond the border of unit 0w105s, and may have been quite large. It was also quite thick, segments being evenly distributed through a vertical distance of 15 cm beginning at a depth of about 39 cm below the present surface. After excavation, the unit profile showed the Oxbow component had a flat top, but an undulating bottom.

Pocket of Charred-white Bone I. For the most part, charred-white bone segments were few and sprinkled widely through the site, but two small concentrations were noteworthy. Pocket of charred-white Bone I appeared in 0w105s at the edge of a concentration of comminuted bone and gritty stones. It was about 38 cm by 18 cm, being oval in horizontal plane (see Plate 14), and it was about 15 cm in thickness. The black sand matrix in which the white segments were concentrated seemed softer and a little easier to trowel than surrounding sand. The feature formed a shallow depression within the Oxbow component.

Pocket of Charred-white Bone II. The second concentration was in unit 55e0n (see Plates 15 and 16). At the time of excavation it seemed to be rather isolated, with few pieces of bone and gritty stone nearby and yellow sand all around it. Later excavations revealed dense concentrations of comminuted bone immediately north and a short distance west. Pocket of Charred-white Bone II was 40 cm by 20 cm, oval in horizontal plane, and about 8-12 cm in thickness. Like the first pocket, the matrix was soft black sand.

Large Concentrations

There was a general overlap between concentrations of whole and large bone fragments and of comminuted bone. For comparison of the two types of bone, large features about to be described will refer to the same regions of the site and the same feature numbers as for the large bones.

Large Feature I. Within Large Feature I, Pulverized Bones I, II, and III occupied essentially the same positions as Bone Piles I an III. The distribution of medium density small pieces also showed a correspondence to large pieces. If medium density is taken as an indication of the boundary of Large Feature 1, then the size was greater than previously estimated. The north border moves 3 m north to 0w20n while the south border shifts 1 m south to 0w24s. On the west edge, however, comminuted bone thinned out much more rapidly than larger bone and the border moved inward. The revised Large Feature 1 was elongated north-south with a length of 13.4 m and a width of 6.1 m.

Large Feature 11. There was no dense concentration of comminuted bone associated with this feature, but pulverized pieces were scattered among the larger bones. The perimeter of the feature could not be interpreted.

Large Feature 111. This area showed a very low amount of large fragments, and small fragments were also low in density except for an area of medium density in the centre.

Large Feature 1V. With the addition of comminuted bone this feature begins to look very complex. Pulverized Bones 1V and V are Pocket of Charred-white Bone 11 formed a cluster of discrete features..... in an area of vaguely concentrated larger bones. The distribution of medium density comminuted bone suggests a north-south dimension for the area of about 10.6 meters. The east-west dimension and overall shape remain unknown.

Large Feature V. The identification of large features was based on the dense concentration of comminuted bone overflowing the limited area viewed in unit 0w105s. The Pocket of Charred-white bones is a part of this feature.

Other Possibilities. The distribution of medaium density comminuted bone in the east part of 60e15s and 60e70s correlates with larger bone there and supports the postulate that a large feature extended eastward.

APPENDIX 11

ECOLOGY OF SPECIES AT THE HARDER SITE

So far as mammalogists are aware (Banfield 1974:xvi), in Canada only one species, the sea mink (*Mustela macrodon*), and two subspecies, the Queen Charolotte Island caribou (*Rangifer tarandus dawsoni*) and the eastern wapiti (*Cervus elaphus canadensis*) have been completely exterminated during the past few thousand years. Several species such as the black-footed ferret (*Mustela nigripes*), the swift fox (*Vulpes Velox*), and the plains bison (*Bison bison bison*) have been extirpated from the Canadian portions of their distribution or survive mainly as an inhabitant of enclosed ranges in parks (Banfield 1974:xvi). There is no evidence that the abundant mammal life which impressed the first European explorers was in any substantial way different from that which might have been encountered in the Western Interior of Canada 2000, 3000, or even 4000 years ago. Hence, it seems reasonable to extrapolate modern habitat to prehistoric animal remains. Information about each type of animal found at the Harder site is summarized below.

Bison Ecology

The plains bison is found in a wide range of habitats from arid plains to aspen parklands and including meadows, river valleys and even coniferous forests. Its original distribution stretched from Great Slave Lake to northern Mexico, from the Rocky Mountains to about the Mississippi River - all of the Great Plains and a band of forest surrounding it. Bison are primarily grazers, living mainly on grasses, forbs, and sedges. Their staple foods are wheat grass, brome grass, wild rye, wild oats, June grass, blue grass, vanilla grass, reed grass, salt grass, foxtail grass, and spear grass. They have also been observed eating horsetail, rushes, sedges, lichens, vetches, pea vine, blueberries, and bearberries (after Banfield 1974:406).

The question of how the bison occupied their range is interesting. If it is assumed that bison were spread evenly through the whole area from Great Slave Lake to New Mexico and wandered randomly, then the presence of bison in the Harder site tells us nothing specific about the surrounding habitat. But this viewpoint (Roe 1951:594) may not be correct.

One might try a different tack by hypothesizing that bison did move from one part of their range to another in a predictable way. The test for this hypothesis lies in historic observations and recent bison studies. I have studied about 150 early sources dealing with the Western Interior of Canada and the adjacent area south of the 49th parallel, many of them previously studied by Roe (1951), and found ample support for the hypothesis. Historic observations indicate that variables (parts of the range, directions of movement, and scheduling) can, in fact, be determined.

David Thompson, at a Piegan camp in the Bow River Foothills in sight of the Rocky Mountains, fall 1987:

> When we related the scarcity of the Bison and Deer they were pleased at it and said it would be to them a plentiful winter. Their argument was; the Bison and Deer have passed the latter part of the summer and the fall of the leaves upon the Missouri, and have made the ground bare of grass and can no longer live there; they must come to us for grass to live on in our country (the Bow River) and to the northward to the Kisikatchewan where the snow is beginning to be on the ground. The winter proved that they reasoned right for by the beginning of December, the herds of bulls which always preceded the herds of cows began to pass

> us for the northward; and shortly after the Stags and small herds of Doe red Deer followed by wolves and foxes. (Glover 1962:48)

Alexander Henry (The younger), east of the forks of the Saskatchewan River near Fort St. Louis, 1808:

> The plains on the S. approach the tops of the banks, but it cannot be called an open country, as spots of wood are frequent. Buffalo abound in winter, when the cold obliges them to leave the plains for shelter among the hummocks, where they find plenty of good long grass. (Henry 1965:483)

Palliser, in reference to the Blackfoot, August 15, 1858:

> This is now nearly the time, too, when these Indians commence to arrive from the plains in the southeast, for the buffalo in winter approach the edge of the woods, and so also do the Indians, seeking fuel and thickwood animals, in case of the buffalo failing them during the winter.... (Palliser Journals p. 92; quoted in' Roe 1951:573)

Denig, in reference to the Assiniboines, Fort Union, 1854:

> From observation and experience they know that the buffalo approach the timber when the snow is deep on the plains to eat twigs and wild rosebuds. They therefore place their camps along some stream in the commencement of winter and await their approach (Denig 1930:504)

Daniel Harmon, at Fort Alexandria, October 20, 1800:

> The buffaloes are as yet a considerable distance farther, out in the spacious prairies. Nothing but severe cold weather will drive them into the woody part of the country, to which they will then come, in order to be less exposed to the wind and weather, than they would be, to remain in the open plains. (Harmon 1911:38)

John Tanner, on the Assiniboine River, during winter about 1615:

> I was compelled to go in pursuit of buffalo. Fortunately the severity of the winter now drove these animals in towards the woods, and in a very few days I had killed plenty of them. (James 1956:119)

Alexander Henry (the elder), three days S.W. of Fort des Prairies, February 1776:

> In the morning we were alarmed by the approach of a herd of oxen, who came from the open ground to shelter themselves in the wood. Their numbers were so great, that we dreaded lest they should fairly trample down the camp; nor could it have

> happened otherwise, but for the dogs, almost as numerous as they, who were able to keep them in check. The Indians killed several, when close upon their tents; but neither the fire of the Indians, nor the noise of the dogs, could soon drive them away. Whatever were the terrors which filled the wood, they had no other escape from the terrors of the storm. (Henry 1969:286)

Generally it appears that the bison summer range was open plains, while the winter range was a partly wooded area which could be aspen parkland, wooded upland, or wooded river valley. The above citations show that the buffalo could be expected to move right into the woods or bluffs of wood when the weather was very cold and stormy, when the condition of snow restricted access to forage on the open plains, or when pasture on the open plains was exhausted. Recent research on the predominantly plains bison herds now in Wood Buffalo National Park provides further insight into the where and why of bison winter movements. First, in regard to extreme cold and windy weather:

> Extreme cold *per se* seems to have little effect on them, and they may be seen grazing on prairies in temperatures of -50°F on calm days. Extreme cold coupled with even a moderate wind (over 8 to 10 m.p.h.), however, will send them to the shelter of the woods. Grazing is then confined to a narrow zone around the edge of the prairies, next to the timber. Winds stronger than about 15 m.p.h. are rare in periods of extreme cold. Likewise, a succession of windy days is uncommon in midwinter. Three days is commonly the duration of the most severe winter storms. Since dense woods, which give protection from the wind, are everywhere well interspersed with grazing areas, the bison are secure from the damaging effects of cold, with or without wind. (Fuller 1966:12)

This description makes clear the advantage of a winter range in close proximity to woods, or, even better, interspersed with woods. Shelter from a prairie storm was always close at hand. Snow conditions also had a bearing on the issue:

> Heavily crusted snow hinders the animals in their foraging and also makes travel more energy-consuming, thus aggravating the effects of prolonged cold. Fortunately, winter thaws are rare on the bison range. Raup (1933) cites several accounts of a severe thaw and freeze about 1865, which was blamed by the Indians for the marked decrease in bison numbers that occurred about that time. Raup also records a thaw of four days'duration in March, 1928, followed by a breeze that made

> foraging on the open prairies difficult. A similar condition was observed following a thaw in February, 1954. On the latter occasion, however, the bison were able to break through the crust for foraging, but were noticeably handicapped in moving from place to place. This difficulty is, of course, less serious for a social species than for a solitary one. (Fuller 1966:12)

Since bison muzzle away snow or tramp it down to get at the buried grass, but do not have the habit of pawing away the snow as horses do, it is easy to imagine the hardship imposed upon them by a winter thaw and freeze. One wonders what the effect of compaction of snow has on the foraging of bison. It has been noted (Fuller 1966:13) that the compaction of snow is rapid on wind-blown plains, lakes, and rivers, but is entirely lacking in the shelter of the forests. If this is so, then foraging even in deeper snow would be easier at the edge of the woods than on the open plains.

When weather didn't force the bison to move from one part of their range to another, fire was often just as effective. Until the advent of European agriculturalists, prairie fires were a common phenomenon throughout the length and breadth of the plains; and could occur at any time of the year, even winter (Hind 1971:1,405; Henry 1965:158). The fires swept across vast areas devouring the bison's grass and sometimes the animals themselves, leaving only charred ground and a little ash for miles around. Between the time a fire passed over an area and the time that the new crop of grass started to grow back (often better than before), the bison had to look to another part of the range for forage. If a prairie fire swept across the plains during the fall when summer grass was dead and drying up, bison would be driven out of the plains and into the parklands for the winter. There is no doubt that the potential (and problems) of the use of fire as a means of animal husbandry was well known to the Indians (cf. Cocking 1908:104; Kurz 1937:331,350; Denig 1930:408-09).

As we have seen, there is good reason to believe that bison movements have a significant element of predictability. Under a variety of winter conditions, (cold-storm, plains forage destroyed, thaw-freeze, compacted snow on the open plains) the best winter range for the bison was parklands or woody area; and they usually went there if they could. Under other winter conditions such as little snow, mild weather with no storms, good forage on the open plains, it could also be predicted that bison would remain out on the plains. Under certain conditions the scarcity of bison was as predictable as abundance under other conditions. Contrary to what Roe (1951:594) has suggested, the movements of bison are not an imponderable subject.

Coyote Ecology (after Banfield 1974:286-89)

The coyote is an adaptable animal found in alpine tundra, boreal forest, aspen parkland, or short-grass steppes. It appears to prefer hilly country with poplar bluffs and willow-lined stream banks. At the time of the Spanish invasion it is believed coyotes could be found from Mexico northward to the Canadian parklands. Since about the sixteenth century, they have been expanding their distribution northward, southward, and eastward. The coyote flourishes even under persecution by man. Normal sources of food are small mammals and carrion and, to a lesser extent, birds, deer, antelope, insects, and vegetation. Stomach analysis shows the coyote diet to consist of approximately 33% cottontails and hares, 25% carrion, 18% mice and ground squirrels, 4% deer and antelope, 2% nesting birds, 2% vegetation, 1% insects, and 14% domestic animals and birds. The coyote, though himself a carnivore, may fall prey to wolves, cougars, and bears.

Swift Fox Ecology (after Banfield 1974:301-03)

Formerly the swift fox was found in arid plains from Texas to southern Canada. This little fox was common in the southern Canadian prairies during the fur trade era, but soon disappeared as the land came under cultivation; and it is now believed to be extinct in Canada. Information from the United States indicates that the food of the swift fox consists of 64% mammals (jack rabbits, cottontails, ground squirrels, pocket mice, Kangaroo mice), 9.6% birds, (prairie chickens and small ground dwelling birds), 8.8% invertebrates (mostly insects), plus a few lizards and fish, and 17.6% vegetable matter (grasses and berries). The chief predators of this species are coyotes, golden eagles, and rarely wolves. The typical habitat of swift foxes is arid short-grass plains and shrubby deserts.

Wolf Ecology (after Banfield 1974:289-95)

Wolves are holarctic in distribution. Originally they were spread throughout all of northern Europe, northern Asia, and northern America. They once occupied all of Canada, except the Queen Charlotte Islands; but have now been exterminated in most of southern British Columbia, the Prairie Provinces, Ontario, Quebec, the Maritime Provinces, and Newfoundland. North American wolves are at present split into 17 subspecies based on slight differences in size, skull, and colour. Four of the subspecies once ranged over the Canadian prairies, parklands and nearby forests; (1) *Canis lupus griseoalbus*, the form occurring in the north-central part of the Prairie Provinces; (2) *Canis lupus irremotus*, a large pale-coloured race, found on the southern plains of Alberta and now very rare; (3) *Canis lupus nubilis*, the buffalo wolf, formerly followed the herds of buffalo across the great plains of southern Manitoba and Saskatchewan and probably extinct now; and (4) Canis lupus occidentalis, a large, often black coloured form found in southern Mackenzie District and northern Alberta. It is not possible to determine which of these subspecies may have been present at the Harder site. In fact, the smallness of the differences suggests than many of the subspecies might be lumped together.

Wolves' diet varies, as would be expected, with the type and density of the game in the area they are inhabiting. They are primarily hunters of big game including moose, bison, caribou, wapiti, mule deer, white-tailed deer, mountain sheep, and (to a limited extent) muskoxen. Large game forms from 68 to 90% of the usual wolf diet. Small game, such as rabbits, hares, marmots, ground squirrels, beavers, muskrats, and mice comprise about 18 to 32% of their diet. Other items such as ground nesting birds, fish, berries, insects and grass are only incidental food items. Wolves prey primarily upon calves and aged and sick animals; the ones most easily caught. In this way they may be said to cull the herds of large game in their territory.

Most wolves under observation today occupy a fixed home range around the den. The home range, during summer at least, occupies anywhere from 100 to 260 square miles. The pack usually hunts and patrols the area by using fixed runways which follow game trails, rivers, roads and so on. The runways that have been measured vary from 27 to 87 miles in length, depending on the size of the home range and the density of big game, and seem to be covered at regular intervals of about one week. Some individuals break their pattern of regular movements and travel much longer distances. In the north whole bands of 'arctic' wolves follow migrating caribou herds to distances of 500 miles during their annual trek from tundra to forest. The buffalo wolf and bison may have been a southern analogy of this wider ranging movement.

Prairie Hare Ecology (after Banfield 1974:88-90)

The prairie hare or white-tailed jack rabbit is a native of the arid short-grass plains of the northern Great Plains. During the last century its range has spread northward beyond the prairies with the spread of agriculture. According to Seton (1929) it was unknown in Manitoba before 1885. It can now be found as far north as Prince Albert National Park. They are generally solitary animals but densities average ten to 20 per square mile and range as high as 69 per square mile. Prairie hares eat a variety of native grasses in summer and are partial to vegetable greens such as lettuce and cabbage when they can get them. In winter they browse on twigs, buds, and bark of shrubs and trees. They frequent the edges of willow thickets and wild rose tangles, as well as the native short-grass sagebrush plains. They seldom penetrate into wooded areas except for shelter during winter blizzards. Prairie hares serve as prey for coyotes, wolves, and foxes.

Marten Ecology

The marten, a mink-sized arboreal weasel, today is typically found in a climax coniferous forest. The southern limit of the present distribution begins about 150 miles north of the Harder site and extends further north, east, and west as does the coniferous forest. It is claimed that martens prefer Douglas fir-cedar-hemlock forests in the west, and black spruce-white cedar swamps in the east and that they will avoid burned over or logged areas (Banfield 1974:317).

Martens are mainly solitary animals. They can be seen hunting both in trees and on the ground, though they are usually considered tree dwellers. Their diet fluctuates depending on the prey species available. Mice are their main source of food (up to 66%). Other important food sources are red and flying squirrels (10%), snowshoe hares and pikas (3 tO 40%), grouse and smaller birds (12%), fruit such as strawberries, blue berries and raspberries (17%), insects such as beetles, bugs and wasps (5%), and occasional carrion in the form of elk and deer carcasses. (Banfield 1974:317) Marten have an insatiable curiosity and appetite, characteristics which lead to their easy capture in all sorts of traps. Marten suffer natural predation from fishers, lynx, coyotes, great horned owls, and golden eagles to only a very limited extent. Their great enemy is man.

The marten, although generally considered an animal of the coniferous forest, at one time probably ranged through the parklands (Hagmeier 1956; Bird 1961). This more southerly distribution is suggested by the fur returns of certain trading posts. For example the posts of the Northwest Company's Lower Red River Department (all in the parklands of southern Manitoba, northeastern North Dakota, and northwestern Minnesota) show consistent returns of marten during the years 1800 to 1808 (Henry 1965). They were usually fourth most numerous furs behind wolves, muskrats, and beavers. The posts most productive of marten tended to be thosenearest the interface between parkland and boreal forest (Dead River, Portage la Prairie, and Lake Manitoba posts), while the posts near the plains took in only a few marten each year. From this we may conclude that, in aboriginal times, marten were probably very rare at the plains edge, but common in those parts of the parklands close to the spruce forests.

Moose Ecology

In North America the moose is an inhabitant of the northern thick-woods and swamps. Although usually considered a forest dweller, it generally shuns the climax coniferous forest and instead prefers to browse among shrubby growth or in aspen-birch parkland. During summer the moose favours lakeshores and alder swamps, but during winter he moves to hardwood slopes. Today, as in the past, moose occupy a range which stretches unbroken from southern Quebec to the Bering Sea. According to Banfield (1974:397) the present southern limit of the moose is approximately 240 km north of the Harder site.

The first European to pass near the Harder site and leave a record of his observations found moose very much closer. During August 1754, Anthony Hendry, in the company of some 400 Indians, travelling on foot and on horseback, came to the South Saskatchewan River, crossed it about 24 km north of Saskatoon, then headed west and a little north (a distance of 58 km) until he reached the elbow of the North Saskatchewan River (at this point he was about 16 to 19 km north of the Harder site), from which he travelled further west along the south bank of the river until reaching Eagle Creek where he paused to fish for trout before continuing westward toward an eventual winter camp along the Red Deer River in Alberta. Hendry's daily observations are strong on landforms, water, and wildlife. At the particular time he passed by the Harder site area, moose and elk were more plentiful than bison.

> August 1754
>
> 18. Sunday, Travelled The Young Men hunting, killed several Moose. I dressed a lame man's leg, He gave me a Moose nose, which is a delicate dish, for my trouble....
>
> 20. Tuesday. ...came to Wapesekcopet River [South Saskatchewan]. It is large; the banks are high; on which grow Brich, Poplar, Hazle, Elder, Fir, etc.; killed 5 Waskesew [wapiti].

> 22. Thursday. Travelled 12 Miles N.W. Level land and dry ridges of woods; saw no water till we put up at night; and that was fresh and good, thank God. Indians killed 6 Waskesew....
>
> 25. Sunday. Travelled 2 miles West up the River in the Archithinue [Blackfoot] track. Level land, no woods but what grow on the banks; plenty of berries.
>
> 27. Tuesday. ...Passed several ponds, & one creek of running water [probably Eagle Creek], in which we caught 17 small Trout. In the evening came to 24 tents of Asinepoet Indians. They have plenty of moose & Beaver flesh, with which they treated us liberally. (Hendry 1907:329-30)

Between Eagle Creek and Battleford, Hendry makes additional observations on Moose;

> August 28. ...killed 2 Moose.
>
> 31. ...Indians killed 4 Waskesew, and I killed one. We are yet to Muscuty plains;...
>
> September 3. ...killed 3 Moose
>
> 4. ...Level land; killed a great many Waskesew and Moose.
>
> 4. ...Level land, with plenty of fruit trees; plenty of Moose, Waskesew, Swans, Cranes, White & Grey Geese, also a few Ducks. We are yet in Muscuty plains [at about Battleford]. Here are a great many Asinepoet Indians. The buffalo has taken the route upwards, and is the reason we have not yet met with Archithinue Natives. (Hendry 1907:330-1)

Hendry's journal leads us to two conslusions about moose. First, the distribution extended at least 240 km farther south in the mid 1700s than it does today. The kills made by Hendry's companions were too numerous to be occasional stray moose from the northern forest. Furthermore, it is not likely that the Indians would be hunting much more than 16 or at most 32 km off the path of the main camp. Hunting in the forest and bringing the flesh back to the camp is thereby ruled out. I conclude that the moose mentioned by Hendry were residents of the immediate area. Secondly, these moose were adapted to an aspen parkland-riverine habitat. The description of the vegetation gives the impression that what Hendry saw would be very similar to what a traveller would see today passing over the same route (with an adjustment for the effects of agriculture). Hendry was led across an open parkland. During the daytime, while travelling, they stayed in the open where travelling would be easiest. But at night they pulled into the closest bush (ledge of trees) for water (and fuel and shelter). The journal unfortunately does not say where the moose were killed, but in view of the moose's known proclivity to water, it is likely that both parkland sloughs and river water were vital components of their habitat.

APPENDIX 111

CHIPPED STONE DEBRIS

Introduction

Out of 126.5m^2 exposed by controlled excavation units, 3874 pieces of chipped stone debris weighing a total of 3.49 kg (7.7 lbs) were collected. In order to learn something about types of stone used as raw material for chipping purposes, the methods by which raw material was broken into usable forms, the phases of stone chipping, which debris is from which phase, and the locations at which certain chipping activities were carried out, several different analyses were applied. To determine materials used, debris was sorted, unit by unit, into classes such as petrified wood, chert, etc., classes were subdivided by colour, and then the number of pieces in each division was counted and recorded. Then debris was re-examined for purposes of technological classification. Major categories such as cores, shatter, and flakes were separated and quantities of each were estimated by volume.

Finer subdivisions within each category would be desirable for purposes of specifying and quantifying details of chipped stone technology. An attempt was made toward fine technological divisions, but the results were unsatisfactory. The problem lay mainly with flakes and the numberous variations in striking platforms, bulbs of percussion, overall shape and so on. Without first-hand experience or experimental background in stone chipping, I found myself handicapped. Having noted that there was a general correlation between size of debris and phase of chipping, I settled for gross characterization of chipping processes in terms of three categories of debris size.

Finally, in order to learn about distribution in the site, cores were plotted individually with the chipped stone tools; and other debris was plotted on a separate planview according to density. The results of these inspections are described in the following sections.

Raw Materials

Debris was sorted, one excavation unit at a time, into material classes and colour subdivisions of those classes. Sorting was done by eye relying only on visual impression. In order to obtain uniformity of classification from first unit to last, the operation was performed approximately two and one-half times, the first half time to set up trial classes and ranges of colour variation, the first complete time through to sort the debris and adjust the classes, and the second complete inspection to standardize identifications. Raw results included about one dozen major classes subdivided into a rather large number of fine shades of colour variation.

Raw results were reworked and simplified by combining several closely affilliated classes (for example, chert, pebble chert, and silicified fossiliferous limestone) and drastically reducing colours into a few subdivisions, each representing broad variation of related shades. The final results are shown in Table A III.1. Petrified wood and chert dominate the collection, together accounting for 87.5% of the chipped stone debris. Quartzite, fused shale and chalcedony make up most of the balance, there also being traces of quartz and basalt in the site. Brown petrified wood and white chert predominate among the colour variations with percentages of 43.5% and 25.5% respectively.

Briefly, the criteria by which pieces of debris were assigned to major classes are as follows:

1. PETRIFIED WOOD. Colour from brown to black with numerous variations of shade and occasionally banded colours. Flat conchoidal fracture. Fracture surface smooth to very rough with dull to glassy lustre. Internal structure matted (petrified peat) or laminated (petrified wood or cryptocrystalline with joints. Tough, sharp (but sometimes irregular) edge.

2. CHERT. Colour from white to black with numerous variations of shade and occasionally mottled colours. Flat conchoidal fracture. Fracture surface smooth to mat with dull to glassy lustre. Internal structure matted (silicified fossiliferous limestone) and jointed or microcrystalline and unjointed. Allows a tough sharp edge.

TABLE A 111.1

Numbers of Chipped Stone Debris Pieces Per Raw Material Class

Material	No. Per Colour	Total Per Class
PETRIFIED WOOD		1724
brown	1678	
black	46	
CHERT		1665
white	986	
grey	258	
black	148	
yellow	113	
pink	160	
QUARTZITE		191
red	108	
yellow	83	
FUSED SHALE (grey only)		140
CHALCEDONY		104
white	87	
tan	17	
QUARTZ (white only)		36
BASALT (black only)		14
GRAND TOTAL		3874

3. QUARTZITE. Colours from light grey to off-white with common variations including yellowish, reddish, violet, greenish and other tints. Flat conchoidal fracture. Granular surface with dull to glassy lustre. Internal structure microcrystalline, but coarse-grained. Sharp to nearly sharp tough edge.

4. FUSED SHALE. Light grey in colour. Flat conchoidal fracture. Fracture surface smooth and dull. Internal structure microcrystalline and unjointed or matted and slightly jointed. Opaque. Sharp tough edge.

5. CHALCEDONY. Translucent. Watery-white occasionally tinted tan-brown, yellowish, or reddish-brown. Flat conchoidal fracture. Smooth surface. Cryptocrystalline unjointed internal structure. Waxy dull to highly lustrous surface. Sharp to very sharp tough edge.

6. QUARTZ. Translucent. Watery-white occasionally tinted grey or reddish brown. Appears here mainly in form of small rounded pieces of quartz crystal shatter. Fracture flat conchoidal. Glassy lustre.

7. BASALT. Black to blue-grey in colour. Opaque. Feeble conchoidal fracture. Smooth but grainy fracture surface with dull sheen. Compact, fine-grained structure. Tough almost sharp edge.

Classification of chipped stone tools followed essentially the same criteria, althouth the results have been recorded in somewhat more detail. The extra detail can readily be generalized, however, into the same classes used for the chipped stone debris, thus allowing direct comparison between raw material debris and material used for chipped stone tools. The comparison has been set up by creating nine classes of chipped stone objects (all debris, all tools, all projectile points, etc.), counting the total number of pieces in each, counting the total number of each type of raw material for that class, and calculating the percentage of each raw material for that class. Then, the categories of raw material being the same for each class, the percentages are easily compared in tabular form (see Table A III.2).

Comparison reveals some interesting differences of proportion between classes. For example, chipped stone debris shows roughly identical large amounts of petrified wood (44.5%) and chert (43%). But amounts of the same materials in tools, while still relatively large, were far from identical. Petrified wood comprised 29.5%, while chert comprised 55.5%. A marked difference can also be seen between amounts of chalcedony debris and chalcedony tools. In this case, some classes of tools contained five to ten times the chalcedony that debris did. Returning to petrified wood-chert comparisons, it will be noted that projectile point preforms comprised exactly equal amounts of these materials, but projectile points were somewhat more than twice as often made of chert as of petrified wood.

TABLE A 111.2

Comparison of Raw Materials used for Stone Tools and Chipping Debris

Material	All Debris	All Tools	Projectile Points	Preforms	Perforators	Small End Scrapers	Thin Uniface Knives	Biface Knives	Residual Tools
Petrified Wood	44.5	29.5	27.5	50	20	20.5	47	28.5	20
Chert	43	55.5	57.5	50	80	57	17.5	71.5	70
Quartzite	5	1.5	0	0	0	0	12	0	5
Fused Shale	3.5	2	5.5	0	0	0	0	0	0
Chalcedony	2.5	11.5	9.5	0	0	22.5	23.5	0	5
Quartz	1	0	0	0	0	0	0	0	0
Basalt	.5	0	0	0	0	0	0	0	0
TOTALS	100%	100%	100%	100%	100%	100%	100%	100%	100%

Note: Comparison by number of pieces per raw material category.

Several factors may have played a part in the differences. One obvious factor is that all of the figures represent some kind of residual situation. Each class is only that part of the original class which was left behind. Not all raw material was left, because some of it was removed as tools. Similarly, not all of tools, were left because some of them were removed when the site was abandoned. This factor does not rule out further analysis.

If projectile points at the Harder site included points made both during occupation of this site and during occuaption of other sites, then it would be surprising if the proportions of projectile point raw materials and debris raw materials were the same. The number of coincidences required for such a match is extraordinary. It would not be surprising, however, to see a very loose similarity since previously occupied sites may not have been too far away and sources of raw material in the region may have provided similar raw materials. At the Harder site a loose similarity between projectile points and debris is seen. Projectile point preforms, on the other hand, presumably made and discarded in this site, should show a very close similarity in proportions to debris. In fact, they do. Values for petrified wood and chert (44.5% and 43% respectively) in the debris were close to the same materials (50% and 50%) used for projectile point preforms.

The low frequency of chalcedony in debris compared to chipped stone tools may be accounted for by very small amounts of raw chalcedony having been brought into the site, but a fairly high proportion of old chalcedony tools having been carried in. Except for one core fragment and a few large flakes, chalcedony debitage consisted mainly of small retouch flakes. Thus it appears that the chalcedony tools at this site may be one part of a tool kit made elsewhere and used up or repaired here.

One last point concerns cultural-technological preference. Speaking about the Plains Cree who with Assiniboines co-occupied the Saskatchewan Rivers Region during most of the historic period, Mandelbaum (1940:215) reports that, traditionally, arrowheads were chipped out of a yellow stone, like flint. Several shades of yellow-tan fine-grained chert were also used for projectile points at the Harder site. The ones present could probably be considered the best specimens in the site and a fairly large minority of the whole projectile point collection, large enough and fine enough to suggest a cultural preference.

The debris tends to support this idea of preference. Yellow-tan material appears to be derived from tiny oblong pebbles as small as 3 cm in length and often enclosed within a smooth jet-black cortex. Such pebbles are usually smaller to start with than exhausted chert or petrified wood cores. Even with skilful reduction by the bipolar technique, it is hard to imagine that a projectile point could have been extracted from these tiny sources. Thus, considering the smallness of the source and the special skill required to work it, the fairly large minority of tools made from this material take on added significance as a probable cultural preference. On the other hand, once the stone worker had surmounted the problem of small size and had obtained a suitable piece for a tool, the remainder of the reduction was probably simple due to the above average chipping characteristics of this type of stone. Therefore, the preference may also reflect a technological aspect.

Cultural-technological preference may also be reflected in the chipped stone collection generally. Returning to petrified wood-chert comparisons, it is notable that debris contains approximately equal amounts of petrified wood and chert; but for tools only about half as many petrified wood specimens as chert specimens were found. Assuming tools represent a broader set of raw material sources than debris and assuming that in the broader set of sources petrified wood and chert were equally available, the predominance of chert tools over petrified wood tools probably indicates a preference for the superior chipping qualities of chert.

In regard to sources of raw material, Semenov (1964:35), speaking about the Old World Paleolithic, has commented that in those countries where flint was not available, man used quartzite, fossilized wood, flinty tufa, ryolite and other rocks, collecting them in the pebble beds of river banks. With substitution of petrified wood for fossilized wood and chert for other rocks, the Semenov statement applies to the Harder site situation. Local surficial geology consists almost entirely of thick glacial deposits. Other than occasional exposures of boulder till on the present surface, local concentrations of stone containing pebbles, cobbles and slabs of petrified wood, chert and other materials suitable for stone chipping are most frequently found along the bottoms of river valleys such as the Saskatchewan River Valleys and Eagle Creek Valley and in the beds of feeder ravines and creeks.

Reduction Techniques and Phases

For a first approximation, chipped stone debris has been classified into three major categories, namely, (1) cores, (2) shatter, and (3) flakes. Cores are the central remnants of rocks subjected to repeated breakage of the external layer. Shatter refers to angular pieces of the outer layers of a rock and occasionally of the core itself representing uncontrolled breakage during knapping. Flakes, on the other hand, are thin broad pieces of the outer layer of a stone whose shape was controlled by the stone worker. All three categories of chipped stone debris have been found at the Harder site. By volume, the estimated size of each is 5% cores, 40% to 45% shatter, and 50% to 55% flakes. During manipulations of the chipped stone debris, cores and flakes were each seen to be composed of several varieties. The following observations provide an impression of some aspects of the reduction technology employed beginning with cores.

Most cores at the Harder site were bipolar cores, the result of a technique which involved smashing one end of an oblong pebble or slab or rock with a hammerstone while the other end rested on an anvil. Binford and Quimby (1963:289-96) have identified and described six varieties of bipolar cores found among chipped stone debris in several Late Woodland sites along the north shore of Lake Michigan. The varieties named for the shape of percussion surfaces at the poles of the core, include ridge and basal area, point and basal area, ridge and basal point, right-angled ridges, opposing ridges, and opposing points. I did not notice the opposed point core at the Harder site but the other five varieties were present (see, for example, Plate 24). As in the Michigan sites, the variety with a ridge of percussion opposite a basal area of percussion predominates. Size was also similar with Harder site specimens having a length of 3 to 4 cm. Block cores (Binford and Papworth 1963:83) must also have been present, judging from some of the flakes, but complete ones were not detected.

Flakes included all four bipolar varieties described by Binford and Quimby (1963:296-98), medium and small flakes from a block core, large, medium and small flakes of bifacial retouch (of Frison 1968:150) (equivalent to broad thinning flakes of projectile point manufacture), a variety of medium and small flakes or unifacial retouch (cf.Frison 1968), and many indertiminate or broken flakes. Plate 25a, showing the chipped stone debris from excavation unit 0w10s, gives an impression of the sizes, shapes, and material of Harder flakes.

In a general way, the major categories of debris tend to be separable according to size. Shatter was mainly large, with some medium-sized pieces, but only a few small ones. Flakes were the opposite, being mainly small, with some medium-sized pieces, and only a few large ones. Cores, which were much fewer in number than either shatter or flakes, tended toward the large to medium end of the size spectrum. The three sizes, large, medium, and small, refer to the greatest measurement of length. Each piece of debris was graded according to its greatest measurement of length, from corner to corner, along one side, or whatever dimension proved longest. It turned out that small flakes clustered around a maximum dimension of 11 to 14 mm while the smallest pieces of debris collected were about 4 mm in greatest dimension. The small size was accordingly defined as 4 to 15 mm to accommodate all debris from the smallest up to and including flakes clustering around 11 to 14 mm. The next cluster in debris size was in the range 20 to 30 mm, and to accommodate this cluster, the medium size was defined as extending from 16 to 30 mm. The large size was essentially a residual category to account for a number of pieces larger than 30 mm. Most large debris was in the range of 31 to 60 mm. The largest piece of debris at the site had a maximum dimension of 110 mm.

After being sorted by size the debris gave the following totals: 2959 small, 821 medium , 94 large. Several observations arise from these totals. Firstly, considering that the overwhelming majority (76.4%) of debris was small flakes, it appears that late phases of stone chipping, such as shaping of new tools and repair of old ones was the predominant chipping activity. This conclusion fits well with the indications for the same activities evident from chipped stone tools. This conclusion does not mean, however, that earlier phases of stone chipping were absent. On the contrary, there was evidence for early phases in the form of slightly broken raw material, shatter, and cores. While the total number of pieces was relatively small, the volume of larger debris, most of it indicative of early chipping phases, was relatively large (approximately 50%). Thus it is clear that both initial and late stages of stone chipping were well represented at the Harder site.

The missing phase was large utilizable flakes. The number of large or medium flakes that could have been made into tools but weren't was extremely low, totalling perhaps one-half dozen in all. Such flakes would have been a prime intermediate objective of the reduction process. No doubt debris was carefully picked over and suitable flakes were removed for manufacture into tools. This would seem the best explanation for the under-representation of utilizable flakes. But even if the stone chippers were purposely removing flakes from the debris, it is still surprising how thorough they were. Knowing how flakes tend to spread out during chipping and how fast they disappear into sand, it would be reasonable to expect more than six utilizable flakes would have escaped their notice. Perhaps the stone knapper checked new detritus after each blow to the core. More likely, primary reduction was done on a hide in order to retrieve all debris for inspection. Whatever the method, the knappers took special pains to collect as many utilizable flakes as possible.

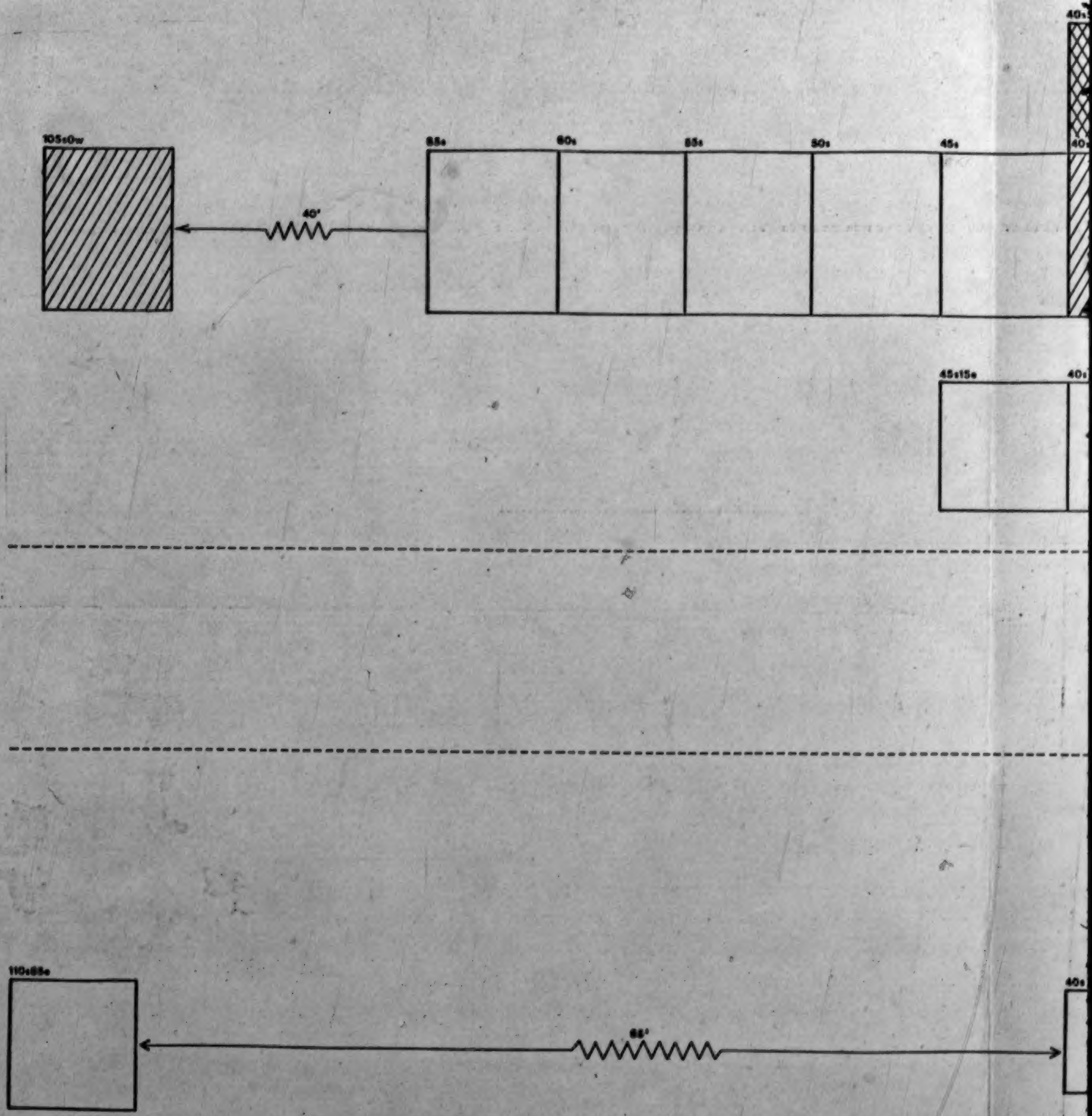
This brings up the last observation about chipped stone technology, which is that debris at the Harder site represents, to an astounding degree, maximum utilization of small, low-intermediate grade raw materials. Virtually every piece of debris was beyond further use because of size, shape, or internal faults. This seems to be a normal condition for sites of all ages in the Dunfermline Sand Hills, but maximization to this degree is unusual in a broader area. For example, the Connell Creek site (Meyer and Dyck 1968) produced a chipped stone collection dominated by white, pink, and blue-black cherts among which both tools and debris are noticeably larger than those of the Harder collection. Large utilizable flakes that weren't used abounded. Many cores were only slightly longer, but much fuller, and not so completely reduced as those at the Harder site. The Connell Creek site, situated on the edge of a creek on the north slope of the Pasquia Hills, is in the heart of one portion of the major chert detritus concentrations of the Manitoba-Saskatchewan escarpment. The fact that the Connell Creek site contains much utilizable waste material is probably due to its location in a 'stone rich' region.

The Dunfermline Sand Hills by comparison with the Pasquia Hills was a 'stone poor' region. If local populations were drawing most of their material from stone poor sources, then, assuming chipped stone needs remained the same, workable material should have been exploited to the maximum degree to meet those needs.

Distribution in the Site

Chipped stone debris has been plotted on two separate planviews of the Harder site. Cores were plotted individually on the same planview as the chipped stone tools (see Fig. 13). The balance of the debris was plotted by density (grams per square foot) in Fig. A III.1. It will be seen that there is no obvious correlation between cores and tools. Cores were sometimes in the midst of a concentration of tools, sometimes on the edge, and sometimes absent. This situation is predictable because cores and tools may have been closely related in time and place (for

Fig. AIII.1. Horizontal Distribution of Chipped Stone Flakes and Shatter in the Harder site.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THE HARDER SITE
A MIDDLE PERIOD BISON HUNTERS' CAMPSITE IN THE NORTHERN GREAT PLAINS

by

Ⓒ IAN GEORGE DYCK

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
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OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF ANTHROPOLOGY

EDMONTON, ALBERTA

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THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled THE HARDER SITE A MIDDLE PERIOD BISON HUNTERS' CAMPSITE IN THE NORTHERN GREAT PLAINS submitted by Ian George Dyck in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Archaeology.

Ruth Gruhn
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Date 10 June 1976

ABSTRACT

This study is an analysis and functional interpretation of the tools and debris found in a Middle Period bison hunters' campsite situated in the parklands of central Saskatchewan. The Harder site, excavated by the author during 1969, 1970, 1971 and 1972, and radiocarbon dated at 3400 years, belongs to the Oxbow archaeological complex.

The study combines detailed descriptions of faunal remains, chipped stone tools, chipping debris, bone tools, pieces of coarse stone and carbonaceous-ashy soil together with relevant ethnographic models in a justified functional classification of items and features.

The remains are characterized by maximum utilization. Seven classes of chipped stone tools are represented by an exhausted assemblage of specimens, dominated by projectile points and small end scrapers. Faunal remains, mainly marrow and grease-rich bison bones, were severely pulverized. Chipping debris, including numerous small retouch flakes and a few small bipolar cores, show utilization of local raw materials. Breakage of coarse stones indicates intensive use for stone boiling and/or roasting.

Thirteen features are identified, ranging from tiny smudge pits to complex dwelling floors, and used as the basis for interpreting organization of activities within the campsite. Dwelling floors indicate the presence of 42 to 56 people at the site, and faunal remains suggest a minimum period of residence of 21 to 42 days. Faunal remains also suggest a parkland environment surrounded the site during Oxbow occupation.

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INTRODUCTION

> "History does not exist; all that exists is debris - scattered, mutilated, very fragmentary - left by vanished ages. Each historian known that by his own labors in scrutiny of the rubbish heaps, he arrives at more and more understanding of what happened in the past." (Lynn White, Jr. quoted in Ascher 1974:10)

DEFINITION OF PROBLEM

The Harder site consists of a thin layer of pulverized bison bones, broken stones, and chipped stone tools buried in a shallow dune depression in the parklands of central Saskatchewan. After seeing the site in ditch profile and noting the kind of projectile points in the disturbed area, I formulated the hypotheses that the site was a single archaeological component, and that the component probably belonged to the Oxbow archaeological complex. Test excavations (Dyck 1970) confirmed both hypotheses.

I continued excavation at the Harder site in order to obtain information about its size, the range of contents, the arrangement of contents into features, and the spatial relationships among features; in other words to learn the contents and structure of the site. Assumptions underlying this strategy were that: (a) archaeological remains consist of several kinds of 'parts'; (b) 'undisturbed' collections of archaeological remains always are deposited in groups or patterns; and (c) the patterns can be observed, interpreted and systematically interrelated in terms of prehistoric human activities. The Harder site shows what complex interpretations can be developed for tools, features, and debris, even in the case of hunter-gatherer sites where remains sometimes seem so sparce or homogeneously mixed as to be beyond the realm of such interpretation.

Past emphasis on projectile point typology and chronology has often meant that the broad range of site contents was left largely unexamined. Thus, for the Northern Plains, simple description of the range of contents of any whole site is new and of considerable interest to archaeologists. However, it is my intention to reach beyond basic description to the processes underlying patterns in the Harder site.

The study focuses on processes mainly within the site and, therefore, may be considered a 'micro-processual' study. It emphasises the lower levels of generalization (Mayer-Oakes 1970:341-46), the small scale systems, but the implication that these small systems are part of larger systems is background to the whole work. Interpretations of tool function, feature function, technology, prehistoric setting, subsistence activities and so on require multiple working hypotheses (often implicit) and comparisons drawn from a much larger universe. Models help to make hypotheses explicit and show where connections to a larger system should exist even if that system is not observable at present.

Once the internal structure of a site has been determined, the interpretation becomes a building block for further investigations. Other sites within the same archaeological complex can be identified as being the same type or as being different. Similar sites can be examined for variations, while at different sites new settlement types can be determined. Given the knowledge of all settlement types within a (large) sample of the sites known to belong to a certain complex, a subsistence-settlement system (Struever 1968) can be established. Thus, the debris of vanished ages can gradually be developed into more and more understanding of what happened in the past.

My investigation of the Harder site might be reduced to a series of fundamental questions:

1) What? What kind of site is this? What was done here and how? What are the contents of the site?

2) Where? Where was the site in relation to prehistoric topography and vegetation? Where was it in relation to raw materials? Where in relation to previous occupations?

3) When? When was the site occupied (season, year)? How long was it occupied?

4) Who? What kind of society occupied the site? How many people were there? What part of the society did this group represent? What archaeological complex is represented?

5) Why? Why were tools left in the site? Why were certain animals hunted and not others? Why are only certain parts of animal skeletons represented in the site? Why was the site located where it was?

Practical considerations such as time, money, and the present state of archaeology in the region have imposed the usual limitations on the study. Nevertheless, the practice of modelling situations to fit observations has helped to maximize available data to the point that a hypothesis with at least some support is provided in answer to every question.

DEVELOPMENT OF NORTHERN PLAINS ARCHAEOLOGY

The durable traces of prehistoric human activities have been found in every part of the Great Plains that has been searched. Moreover, a rich written record of Indian life in the Northern Plains during the 1700s and 1800s survives in the form of fur trade and exploration journals and narratives. In addition, during the early 1900s, ethnologists did their best to record recollections of the nomadic Indian lifestyle. Thus raw data and comparative material for Plains prehistoric studies are abundant.

Archaeological investigations of the northern Plains began in the late 1800s with investigations into the burial mounds of the northeastern periphery (Bryce 1885). Mound investigations were continued into the early 1900s by scientists such as Montgomery (1908) and Nickerson (Capes 1963), but archaeology then entered a period of doldrums lasting 35 years through two world wars and a depression. Following World War II, River Basins Survey crews salvaged large quantities of data from late prehistoric earth-lodge villages in the Missouri River Trench as army engineers engaged in a series of post-war dam building projects. Outside the Missouri River Trench, however, the development of northern Plains archaeology is the story of a few isolated individuals struggling to carry out studies on a part-time basis with insufficient funds. Consequently, throughout most of the northern Plains the rich archaeological resources have barely been tapped.

In summarizing important developments in Northern Plains prehistory between 1942 and 1967 Mayer-Oakes (1969:42-44) singled out eight key areas of factual and theoretical development: 1) the single most important program has been the intensive investigations of Middle Missouri Plains village sites by Smithsonian institution parties; other important developments include 2) the subject of Paleo-Indian diversity and distribution; 3) Meso-Indian gap-filling; 4) the use of named projectile point styles as diagnostic markers for the dating of sites; 5) the beginning of functional studies such as White's (1952,1955,1956) work on butchering techniques; 6) the use of ecological frameworks; 7) the recognition of extra-local connections; and 8) the preparation of syntheses. Except for differing opinions about degrees of advocacy and application, most workers would agree with these developments.

With the major points of reference for Northern Plains prehistory nearly established, Mayer-Oakes (1969:44-45) predicts that the future will hold significant development of ethno-historic studies, more synthesis, and more micro-analytical studies. He further suggests, and I agree, that the best possibility for functional or largely interpretive advances lie in the micro-analytical studies. Mayer-Oakes' predictions seem to be in tune with changes related to the "new archaeology" (Binford 1972:17).

THE OXBOW COMPLEX

According to projectile point typology, the Harder site belongs to the Oxbow complex which is a little known, Early Middle Period bison-hunting complex. The Oxbow complex is preceramic and until recently was thought to be the oldest side-notched projectile point tradition in the northern part of the Plains area, representing first reoccupation after the Altithermal drought ended some 5000 years ago (Conner 1968:16). Mayer-Oakes (1960:116-8) has suggested that Oxbow projectile points are similar to those of the Eastern Archaic side-notched style which date from the period 3000 to 6000 B.C. and are found in the (eastern) prairie-woodland border zone of central North America. In Mayer-Oakes' opinion, Oxbow (projectile points), like other variations of the major Archaic side-notched style, represent a unit out of a changing continuum of notched point style history. Other archaeologists familiar with the western edge of the plains have noticed similarities and possible associations between Oxbow materials and later McKean complex materials (Syms 1969:171-2) and between Oxbow and earlier Bitterroot or Mummy Cave materials (Reeves 1969:32). All archaeologists agree that too little is known about the Oxbow complex and its neighbours for the establishment of either spatial or temporal connections.

The Oxbow type of projectile point is side-notched with notches straddling the widest part of the blade, and basally thinned with thinning flakes extending on both faces up to or slightly beyond a line joining the distal juncture of the notches. Thinning usually produces a pronounced basal concavity. Oxbow projectile points have been found scattered over the southern halves of the three prairie provinces and the northern parts of adjoining states. Fig. 1 is a depiction of the idealized Oxbow type from a recent publication (Bryan 1967:284).

Although first excavated at the Oxbow Dam site dated at 3250 B.C. ± 130 (Nero and McCorquodale 1958), Oxbow remains are best known from layers VII and VIII at the Long Creek campsite radiocarbon-dated at 2663 B.C. ± 150 and 2693 B.C. ± 150 respectively (Wettlaufer and Mayer-Oakes 1960). In addition to side-notched basally thinned projectile points, the Long Creek site revealed unnotched basally thinned projectile points, plano-convex triangular end scrapers with either a high dorsal ridge or a flat dorsal surface, thin side scrapers, circular to oval bifaces, a small pecking hammer, more than 3000 chipped

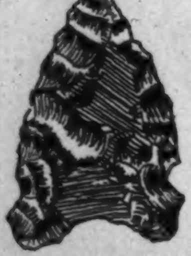


Fig. 1 Depiction of the Oxbow Projectile Point Type (after Bryan 1967:284).

stone flakes, a number of small broken bone tools including awls, beamers, and scrapers, a fragment of clam shell with a hole drilled through it, a small feature consisting of a central hearth surrounded by large and small post molds and interpreted as a hide smoking or ceremonial feature, the comminuted bones of 13 bison, three canids, and one ground squirrel, and eight small patches of ash. Due to the regular absence of certain bison parts, it was inferred that the Long Creek site was a campsite.

Small samples of Oxbow materials have been reported from a variety of other sites scattered across the Northern Plains (see Table 1 for names and references and see Fig. 2 for locations). Most of these sites have produced only a fraction of the material found at Long Creek and add little to our knowledge except to emphasize that Oxbow sites are abundant and widespread. On the other hand certain sites hold great potential for Oxbow investigations. The Connell Creek site is comprised of a large surface collection of stone tools and chipping debris amounting to approximately two and one-half times the number of specimens found at Long Creek; but an analysis is not yet available. The Carruthers collection is approximately the same size as Long Creek, but information from it has also not yet been thoroughly analyzed. The Harder site is comparable to the Long Creek site; but the Harder collection is about three times as large.

Noteworthy items from some of the smaller collections are: a copper crescent from the Castor Creek site; rolled copper fragments from the Gray site; and the common mixture of lanceolate or triangular 'projectile points' with Oxbow materials. Oxbow copper probably originated in the Great Lakes area. The mixture of unnotched triangular bifaces (sometimes thought to be McKean projectile points) with Oxbow

TABLE I

OXBOW COMPONENTS IN THE NORTHERN PLAINS

Site	Reference
MANITOBA	
Swan River (FbMi-5)	Gryba (1968)
Tailrace Bay	Mayer-Oakes (1970)
Cherry Point	Syms (1974); Haug (1975)
SASKATCHEWAN	
Oxbow Dam	Nero and McCorquodale (1958)
Long Creek	Wettlaufer and Mayer-Oakes (1960)
Klein	Nero (1957)
Connell Creek	Meyer and Dyck (1968)
Moon Lake	Dyck (1970)
Harder	Dyck (1970)
East Pasture	Wilson (1972)
Gray Mass Burial	Foster (1972)
Carruthers	Dyck (1972)
FlNn-6 & FlNm-2	Forsman (1972)
Greenwater Lake Burial	Hartney & Walker 1974
ALBERTA	
Castor Creek	Wormington and Forbis (1965)
Narrows	Milne-Brumley (1971)
Grande Prairie	Thomson (1973)
Coulee View	Forbis (1970)
Cypress Hills (DjOn-26)	Gryba (1972)
Fullerton	Taylor(1969)
Calling Lake (GhPh-102)	Gruhn (1969)
Scheideman	Losey and Losey (1969)
MONTANA	
Billy Big Spring	Kehoe (1955)
NORTH DAKOTA	
No reported sites	
SOUTH DAKOTA	
39DA201	McNerney (1970)

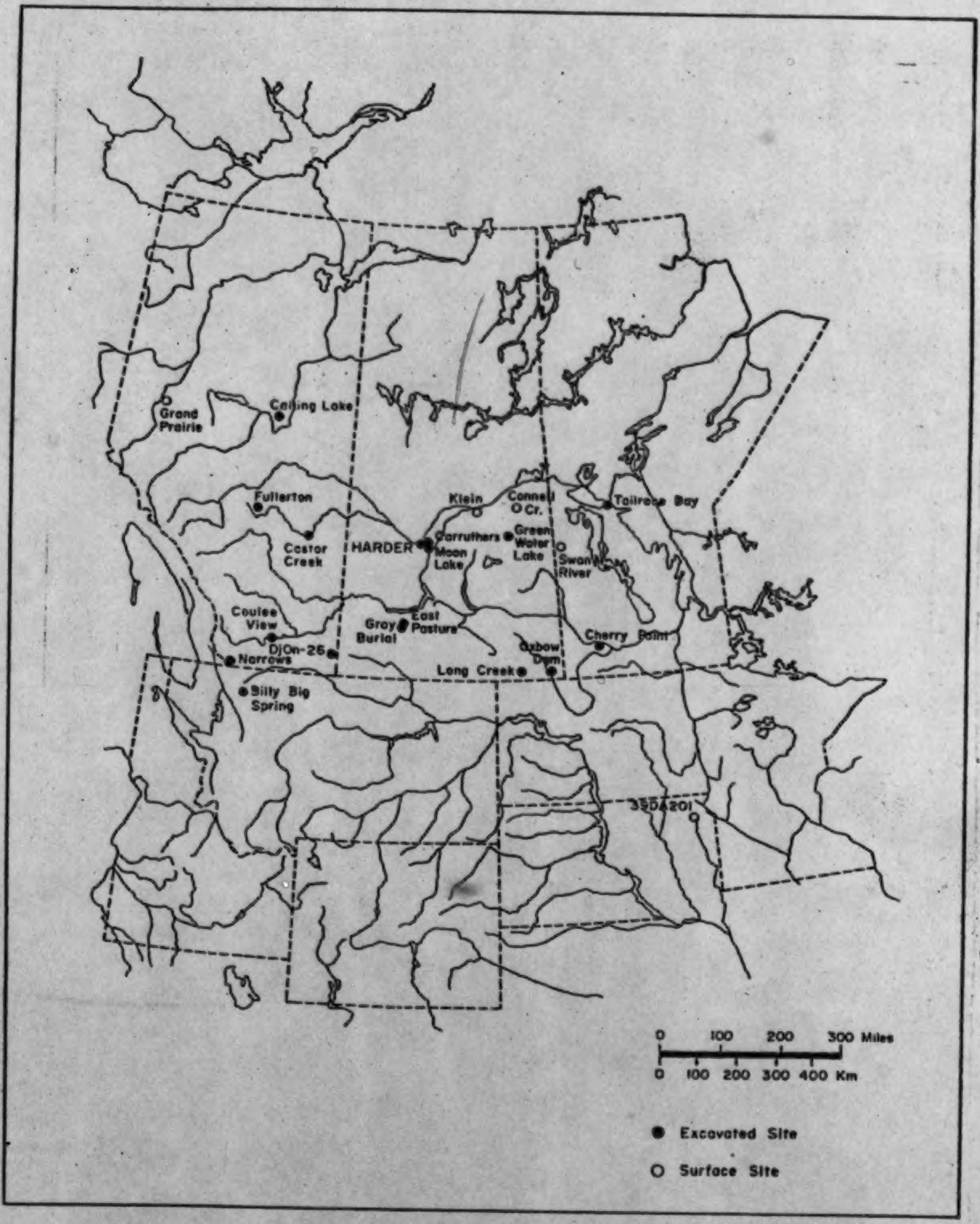

Grand Prairie
Calling Lake
Fullerton
Castor Creek
HARDER
Carruthers
Moon Lake
Klein
Connell Cr.
Green Water Lake
Swan River
Tailrace Bay
Coulee View
Gray Burial
East Pasture
DjOn-26
Narrows
Billy Big Spring
Long Creek
Oxbow Dam
Cherry Point
39DA201
0 100 200 300 Miles
0 100 200 300 400 Km
● Excavated Site
○ Surface Site

Fig. 2 Locations of Certain Oxbow Sites in the Northern Great Plains.

collections is examined in the present study and explained as a logical occurrence at projectile point manufacturing stations.

Most Oxbow sites have not been sufficiently studied to determine the nature of internal activities and subsistence-settlement types. It is believed that the Long Creek, Moon Lake, and Harder sites were campsites; and it is known that the Greenwater Lake and Gray sites were single and mass burials respectively. The balance of reported Oxbow sites seem to be within the campsite range of variation, but there is of course no detailed analysis available to support this conclusion. Apparently missing from the sample of Oxbow sites so far reported is the communal bison kill site. Absence of Oxbow communal kills is puzzling in view of the abundance of communal kill sites representing earlier and later complexes, the large numbers of bison in Oxbow campsites, and the known use of buffalo jumps by contemporary groups such as those at the Kobald site in southern Montana (Frison 1970a).

In summary, the Oxbow complex is very poorly known. Detailed examination of an undisturbed Oxbow component would seem the best way to improve our knowledge, and once there is a good understanding of one site, survey and exploration of other Oxbow settlements will become not only easier but also more meaningful.

MODELS

> "We always bring to our observations some expectations in the form of 'models' of nature. These are our particular cognitive maps of what nature is like and what we can expect from it." (Binford 1972:244)

In order to explain relationships one must resort to model building which involves specifying "the properties of an extinct organization which would accommodate all the observed relationships between the attributes of the archaeological record in any given location" (Binford 1972:18). However, the problem then arises that several different models can be used in explanation of the same evidence. For example Cree Indians sometimes tell about little people who lived in the sand hills and made arrowheads (Ahenakew 1973:97):

> "It seems that these Ma-ma-kwa-se-suk live beneath the ground in the sand hills or on river banks. They are very small, no taller than a two-year-old child.... The women noticed how nervous the little things were, and so they moved a short distance away, and when they looked again the creatures had vanished. There were tracks, but they led nowhere; then on the side of a little hill, where the sand was disturbed, the women found a flint arrowhead. They had been told of the sounds that came from underground where the little people worked to shape these flints; they did not want to look further, or trouble the little ones.

On the other hand archaeologists with strong beliefs in the antiquity of man bring a completely different set of models to bear on the same flint arrowhead. An archaeologist might argue that the important difference between his model and the Indian model is that his model accommodates all observed relationships of the archaeological record, while the traditional explanation bends the observations to fit the model. However, it is more likely that the difference lies in the perspectives of the observers, than in the methods of observation.

Models can be separated into different levels of generalization in the same fashion as archaeological units can. At a fairly high level of generalization are models of cultural systems. Ideas about how models of sites may be assembled into models of cultural systems have been advanced by several scholars (for example Struever 1968; Clarke 1968; Chang 1967, 1968). In all cases, relationships tying individual sites together into a cultural system are based on continuities in absolute time, geographic location, and cultural form.

The frame of reference underlying the present work is a subsistence-settlement model (Struever 1968). Given a systemic view of culture and environment, and assuming that any culture articulates with its environment through a highly complex set of relationships, it is expected that the archaeological remains of an extinct subsistence-settlement system will reveal patterns corresponding to the behavioral aspects of the extinct system. The particular patterns sought in this type of model are subsistence patterns related to exploitive and maintenance technologies; and settlement patterns related to the manner in which the system was segmented and partitioned to exploit the environment (Struever 1968:134-5).

Subsistence-settlement models may be divided into a number of different kinds such as hunter-gatherer strategies, agricultural strategies, industrial strategies and so forth. A hunter-gatherer strategy seems appropriate to the Harder situation and a focal-diffuse model (Cleland 1976) shows the options available to hunter-gatherers quite well. Focal adaptations are those that are centred economically on a single species or a few species that can be exploited by similar tools and techniques. Diffuse adaptations occur where resources are varied and scattered and are based on the careful scheduling of exploitation so that natural availability of resources is maximized and alternative resources are available. Evidence at the Harder site suggests a focal adaptation based on the traditional Plains bison economy.

Focal adaptations require, above all else, a high degree of resource reliability (Cleland 1976:61-63). Resource reliability is largely determined by availability, but it is also a function of storage technology. Storage methods such as drying and freezing are vital aspects of focal adaptations. A strong characteristic of focal adaptations is that functional categories of tools tend to be limited.

On the other hand, while functional variety is small, production of each variety is often prodigous.

Focal adaptations imply a regularized pattern of extraction and a corresponding consistency in group size. Likewise there is a low degree of variability in activities within various sites occupied during the course of the subsistence round and the number of settlement types is quite limited. The usual pattern of site utilization is brief, intensive occupations in comparable geographic or ecological positions. Focal adaptations are specialized and very stable. Finally, the rate of change in technological, socio-political, and ideological aspects of such systems is very slow.

Historic Indian bison hunting on the Northern Plains was a focal adaptation and the literature concerning the Northern Plains Indians is a rich source of relevant models, one of which is the annual subsistence-settlement cycle. According to Ray (1971:82-83), grassland-parkland Indians such as the Assiniboine followed a regular schedule of activity. During the winter, bands resorted to the parklands for shelter, bison hunting, and wolf trapping. Late winter and early spring was a difficult time when bands did some fishing (and according to Mandelbaum (1940:204) the Plains Cree also did some elk, deer, and bison hunting with varying success). Raiding parties were common during spring and early summer. In middle and late summer bands drifted into the open grasslands to prey on large bison herds. During late summer and early autumn the Assiniboine jouneyed to the Mandan villages to obtain Indian corn. This option was not available in Oxbow times, so the Plains Cree habit of avoiding the poor-tasting buffalo meat of August in favour of berries and prairie turnips (Mandelbaum 1940:204) is substituted for the August part of the cycle. During the berry period Cree bands moved into the low hills and valleys. During autumn and winter the groups returned to the parklands for bison pounding, beginning a new cycle.

Ethnographic sources (eg. Oliver 1962; Sahlins 1968:41) suggest that such groups were large during summer and very small and dispersed in winter. Contrary to this suggestion, my impression from the historic literature is that group size varied somewhat but was occasionally enormous during winter as well as summer. I believe that the annual subsistence-settlement will eventually be clarified and filled out with additional historical research. In the meantime several rough settlement types can be proposed as components of the Northern Plains system.

1) Winter camps - size and population uncertain; duration, probably a month or more; a campsite strewn with bison bones and comprised of tipis, sweat lodge, ceremonial structure and associated with a communal kill site and butchering area; location, parklands.

2) Spring camps - size, population and duration unknown; campsite same as other camps except reduction of mammal bones with the possible addition of fish bones; location, river valley near rapids.

3) Mid-summer camps - same as winter camps but location in grasslands or parklands.

4) Late summer camps - same as mid-summer camp except bison bones absent and location in sandy or riverine areas.

5) Buffalo kill sites - characterized by dense concentration of bones; usually located near a marked change in topographic relief. Historic pounds, surrounds, traps, jumps and other killing methods are known in great detail (cf. Arthur 1974 and others) and are among the most successfully interpreted archaeological sites on the Northern Plains (cf. Forbis 1962; Frison 1974).

6) Butchering and processing stations - butchering took place at the kill site; processing took place near the campsite or both.

7) Chipped stone quarries - probably low visibility; sources such as cobble deposits in river valleys and glacial drift.

8) Burials - seem to have been mainly scaffold burials in historic times with some primary and secondary interments.

Since many of the above settlement types are broadly similar it is apparent that attention to fine details, both historical and archaeological, will be required to distinguish settlement types.

Another group of models concerning aspects of sites and features have been generated by archaeologists themselves. For example, excellent models are available for the method and sequence of bison butchering (see Frison 1973:85-8) as well as for discarding certain parts of butchered animals at kill sites and packing other parts to camp sites (see Daly's (1969) schlepp effect). Even the rates of consumption (Wheat 1972) and the relative economic importance of various game animals (eg., Daly 1969) have been modeled on archaeological evidence. Models are available for various stone chipping techniques (Crabtree 1972) and stone tool rejuvenation techniques (Friston 1968). Certain models for features such as rock-lined hearths, post molds, and subsurface storage pits are essentially common knowledge. Many tool functions implied by names such as side scraper, stone kinfe, utilized flake seem to reside somewhere between implied models and common usage. These are the principal models that will be used in the following study.

SETTING, STRATIGRAPHY, EXCAVATIONS, AND AGE OF THE HARDER SITE

SETTING

The Harder site is on the northern periphery of North America's Great Interior Plains at the juncture of 52°12'37" North Latitude and 107°03'01" West Longitude. This is about 23 km west and 10 km north of Saskatoon, Saskatchewan (see Fig. 3 and Plate 1). The site occupies a shallow dune depression (see Plate 2) near the north edge of an undulating sand plain known as the Dunfermline Sand Hills. Surrounding the sand hills are flat lacustrine plains and pot-holed till plains which may be reached a little less than 2 km north of the Harder site. The dominant vegetation at the site and in the sand hills consists of aspen poplar trees, often seen in dense stands known locally as bluffs. In marked contrast to the sand hills are nearby plains, now almost totally cultivated but once dominated by prairie grasses with clumps of aspen and willows in low spots (according to Dominion Land Survey notes and maps on file with Saskatchewan Department of Tourism and Renewable Resources, Lands and Surveys Branch).

The Dunfermline Sand Hills and surrounding plains are part of a larger region called the Saskatchewan Rivers Plain which in turn is a western section of the second of Hector's three prairie levels (see Warkentin 1964:157-9). Some 40 km west of the site is the Missouri Coteau marking the beginning of the Alberta Plateau (Richards 1969) or the third prairie level which sweeps west to the foothills of the Rocky Mountains. Some 365 km east of the Harder site is the rim of the second prairie level through which regional rivers descend to the

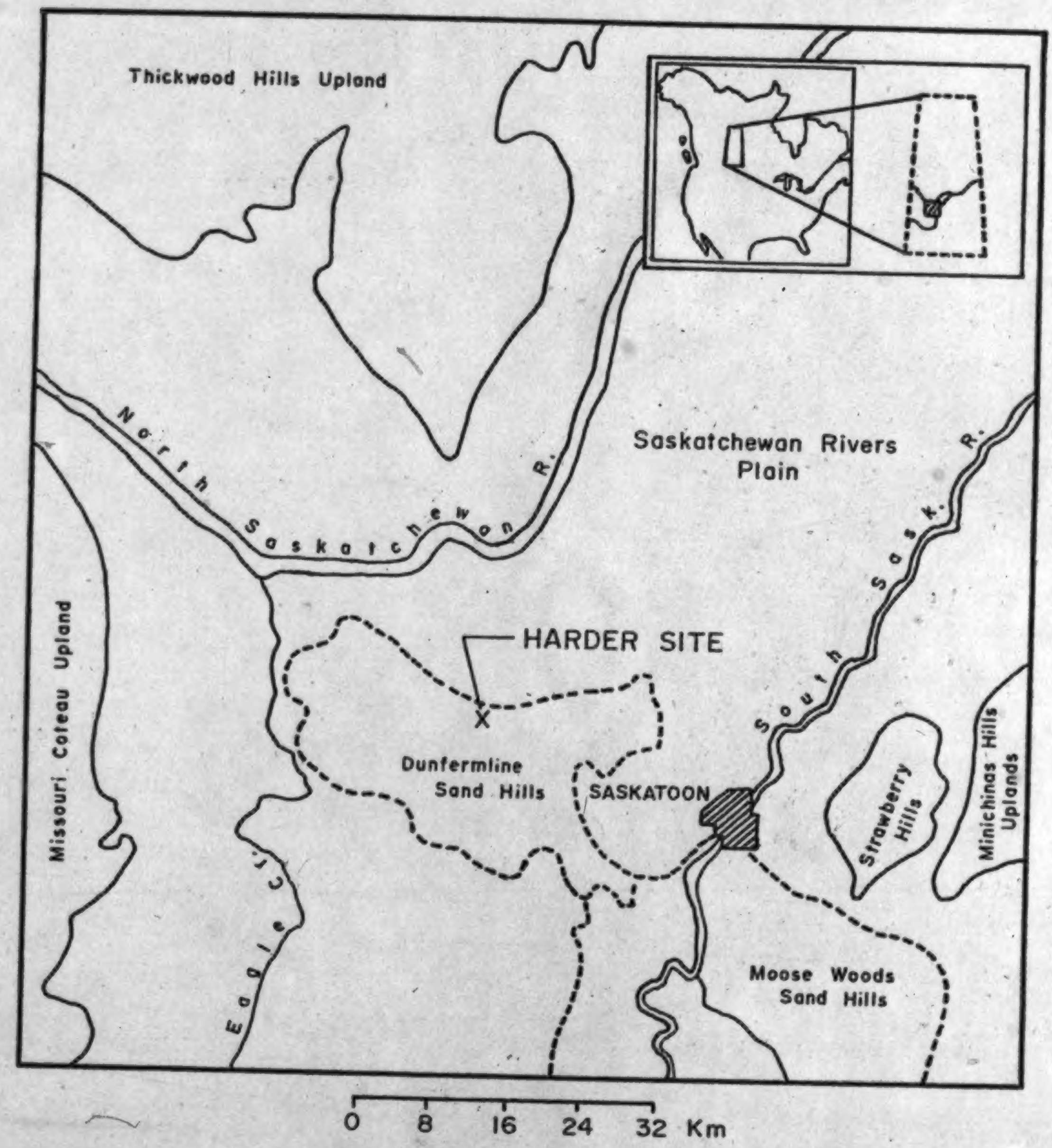

Thickwood Hills Upland
North Saskatchewan R.
Saskatchewan Rivers Plain
South Sask. R.
Missouri Coteau Upland
Eagle Cr.
HARDER SITE
Dunfermline Sand Hills
SASKATOON
Strawberry Hills
Minichinas Hills Uplands
Moose Woods Sand Hills
0
8
16
24
32 Km

Fig. 3 Location of Harder site (after preliminary map of physical regions of the Saskatoon Map Area, by Saskatchewan Institute of Pedology, 1971)

first level, the Manitoba Lowlands. The Harder site lies midway between the North and South branches of the Saskatchewan River approximately 185 km southwest of the junction. Surface water between the rivers is generally stagnant and seasonal, the area being spotted with innumerable shallow saline sloughs. The two great rivers and the creeks feeding them generally flow from southwest to northeast following the gradient of the Saskatchewan-Nelson drainage basin.

While water courses tend to be oriented roughly west to east, vegetation zones change from south to north, the Harder site being in an ecotone between southern grassland and northern boreal forest. The ecotone a 30 to 160 km wide crescent that is neither grassland nor forest but part of each, has been recognized as a biological community in its own right and a particularly favourable place to live and hunt from earliest recorded time. Indians moved into this transition zone from both forests and plains when winter weather forced the bison herds off the plains into the sheltering aspen groves (see Ray 1971). During the late 1700s and the 1800s fur traders routed their main transportation through the parkland ecotone, crowding provision posts one beside the other at various stages in a long chain. When Canadian Government explorers examined the West in the 1850s, prior to agricultural settlement, they concluded that the parkland zone contained the best (mixed) farmland available and named it the 'Fertile Belt' (Hind 1971). Only two decades later, just before agricultural settlement, Indians of the Western Interior relinquished their claims on tribal territories in return for reservations. The lands selected for reserves were mainly in the Aspen Parkland ecotone. Thus the parkland surrounding the Harder site was of considerable historical significance (for shelter, fuel and concentrated game); and, I presume, it was important for similar reasons in prehistoric times as well.

The nature of the parkland has been carefully analyzed and described (eg. Bird 1961) and the diversity present in the physical landscape has been properly stressed (eg., Laycock 1972). An excellent description of the physical environment specifically in the Saskatoon area including geology, pedology, climate, geotechnology, and other environmental components is available for persons wishing detailed information about the Harder site locale (see Christiansen, Whitaker, and Meneley 1970). One important aspect still under initial study, however, deserves consideration here. The aspect concerns possible shifts in parkland location; and, in particular, the length of time the parkland has occupied its present position.

One factor long thought to be responsible for grassland-forest fluctuations is fire (cf Hind 1971: Vol. 1, pp. 308, 318). The idea that aspen groves not only sprang up along the Northern Plains periphery but also began a marked southern expansion after prairie fires were checked by settlement is commonly held (cf. Stewart 1956). According to this view the Harder site might have been part of an open grassland and the parkland zone might have been much farther north only 100 years ago. On the other hand research by Maini (1960) shows that post-settlement invasion of grasslands by aspen has been very limited. Maini (1960:214) concludes that the creeping of aspen groves into the northern prairie is a misconception partly caused by a great increase in height of already existing trees, an increase that elevated the aspen from a position of obscurity to one of prominence.

To test Maini's conclusion I compared vegetation notes made by Dominion Land Surveyors during the late 1870s and early 1880s on sections and townships around the Harder site with modern air photos of the same region. The air photos are, of course, much more detailed than the surveyors' notes, but it appears that the vegetation surveyors saw was very similar to what one sees today. Plate 3 shows fairly dense clumps of poplar interspersed with grassy areas in the Harder site locale during the late 1930s. Plate 4 shows that, except for reductions due to cultivation, the sizes and shapes of the aspen clumps were exactly the same in 1956. Fig. 4 is the map of an 1884 survey line running along the east boundary of Section 27 Township 37 Range 8 West of the 3rd Meridian, bisecting the Harder site. The map indicates that sections 26 and 27 were dominated by willow and poplar brush, the term brush probably referring to aftergrowth following a fire. More general descriptions of the township containing the Harder site show that trees held very similar distributions in the 1880s to what they hold now, and thus Maini's conclusion of very limited change in the parkland seems true for the Harder site area for at least the past 90 years.

Outline of T37-R8-W3 by A.G. Cavana, 1883 (Anon 1886: 108)

> The township is timbered throughout with clumps of poplar and willow, which have been burnt over by fire, forming brules. A considerable quantity of this wood might be used for fencing or fuel.

Outline of T37-R8-W3 by F. Purvis, 1884 (Avon 1886: 108)

> ...about half the area of the township is covered with a dense growth of young poplar and willow. The brush occurs in clumps, with intervening patches of prairie.... The east appears to have been, at one time, covered with a dense growth of poplar, now destroyed by fire.

Although fires may influence the appearance of a plant community, general climatic changes are thought to be the factor having greatest bearing on major vegetative changes. With this in mind, Pettapiece examined the distribution of soils in relation to parkland vegetation and found a general correspondence between present parkland location and

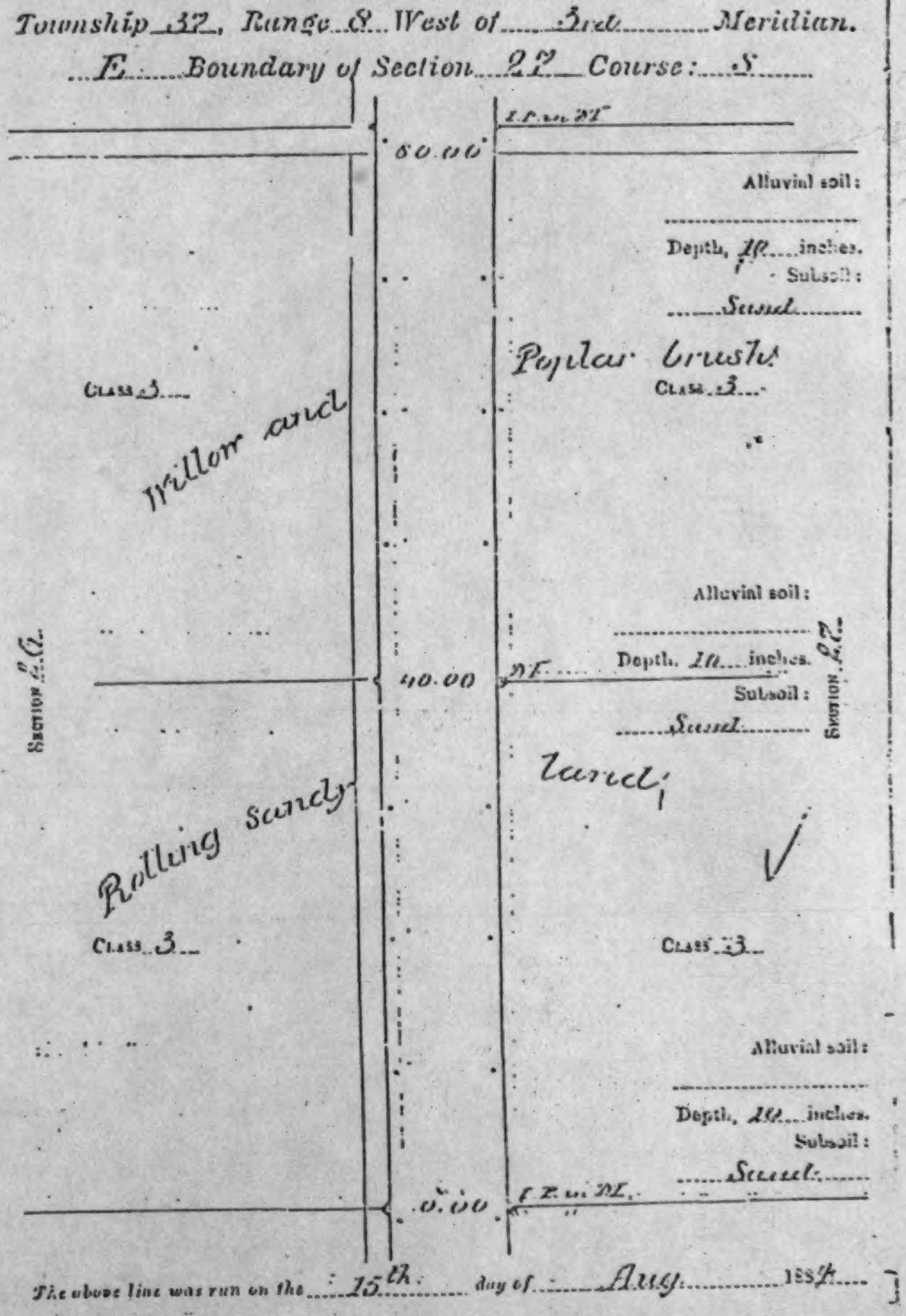

Township 37, Range 8 West of 3rd Meridian.
E Boundary of Section 27 Course: S
80.00
Alluvial soil:
Depth, 10 inches.
Subsoil:
Sand
Poplar brush
Class 3
Class 3
Willow and
Alluvial soil:
Depth, 10 inches.
Subsoil:
Sand
Section 26
Section 27
40.00
Land
Rolling sandy
Class 3
Class 3
Alluvial soil:
Depth, 10 inches.
Subsoil:
Sand
0.00
The above line was run on the 15th day of Aug 1884

Fig. 4 Map of the East Boundary of S27-T37-R8-W3 from the 1884 Field Notes of Frank Purvis, D.L.S.

the soils expected in a parkland zone. Pettapiece (1969:111) concluded that if past changes in climate (and major shifts in vegetation) did occur as others have suggested, then soils do not reflect the changes. Since several hundreds or even thousands of years are required for conversion of one soil type to another (Pettapiece 1969:109), it appears that the present parkland has been stable for a considerable period of time.

Palynological studies in southern Saskatchewan provide a longer perspective and show that, following deglaciation, spruce forest existed along the Missouri Coteau from at least 11,700 B.P. until about 10,000 B.P. (Parizek 1964; Kupsch 1960). Shortly after 10,000 B.P. prairie conditions prevailed in south-central Saskatchewan; and at the Clearwater Lake site on the Missouri Coteau some 190 km south of the Harder site, prairie conditions endured to the present (Mott 1973). Post-glacial vegetation zones tended to follow the retreating glacial ice northward. Near Prince Albert, Saskatchewan, some 145 km northeast of the Harder site, a spruce forest occupied the area about 11,500 B.P. Apparently the spruce forest was soon replaced with open grassland containing some aspen, according to pollen remains at Lake A (Mott 1973). The grassland lasted a considerable time and then reverted to a mixed forest similar to the one currently covering the area (mott 1973). A similar forest resurgence may have occurred about 2500 B.P. in the Riding Mountain area (Ritchie 1969). On a broader scale, Bryson and Wendland (1967:292) have suggested that the last major southward shift of the boreal forest occurred around 3500 B.P. during the middle of the sub-Boreal climatic episode. Some 1000 years later, at the beginning of the sub-Alantic climatic episode, the boreal forest became much wetter but did not change position. If Bryson and Wendland are correct and if the shift from grassland to mixed wood forest at Prince Albert happened about 3500 B.P., then we may presume that the parkland shifted south into its present position at the same time, and, therefore, that the Harder site was surrounded by parkland during Oxbow occupation. Faunal remains found at the site support this conclusion (see chapter 3).

STRATIGRAPHY

The stratigraphy at the Harder site is illustrated in Plates 5 and 6 and Fig. 5. The soil profile, excavated to a maximum depth of 130 cm, consists of three sandy zones capped by a layer of organic matter. Readers familiar with the report of preliminary excavations at the site (Dyck 1970) will notice slight descriptive changes in this report involving combination of two zones (zones 2 and 3) into one (present zone A), and the separation of organic from mineral horizons in conformity with the National system of soil classification adapted by Moss (1965:24-7).

In undisturbed areas, the Harder site surface is a mat of twigs, roots, fallen aspen, and prickly rose bushes mixed with quantities of leaves, grass, and grass roots. This organic mat varies from relatively undecomposed material at the top to a mixture of partially and completely decomposed matter and traces of charcoal at the bottom. The average thickness of the organic horizon is approximately 12 cm.

Zone A, the first mineral horizon, is a layer of fine-textured yellow to yellow-grey sand overlying the Oxbow occupation. The layer is 15 to 21 cm in thickness. In many parts of the site the top 3 to 6 cm of Zone A is dark grey in colour, apparently a modern Ah soil horizon in the process of formation. A few fragments of bone and a few stone chips were found at the contact between organic matter and grey-

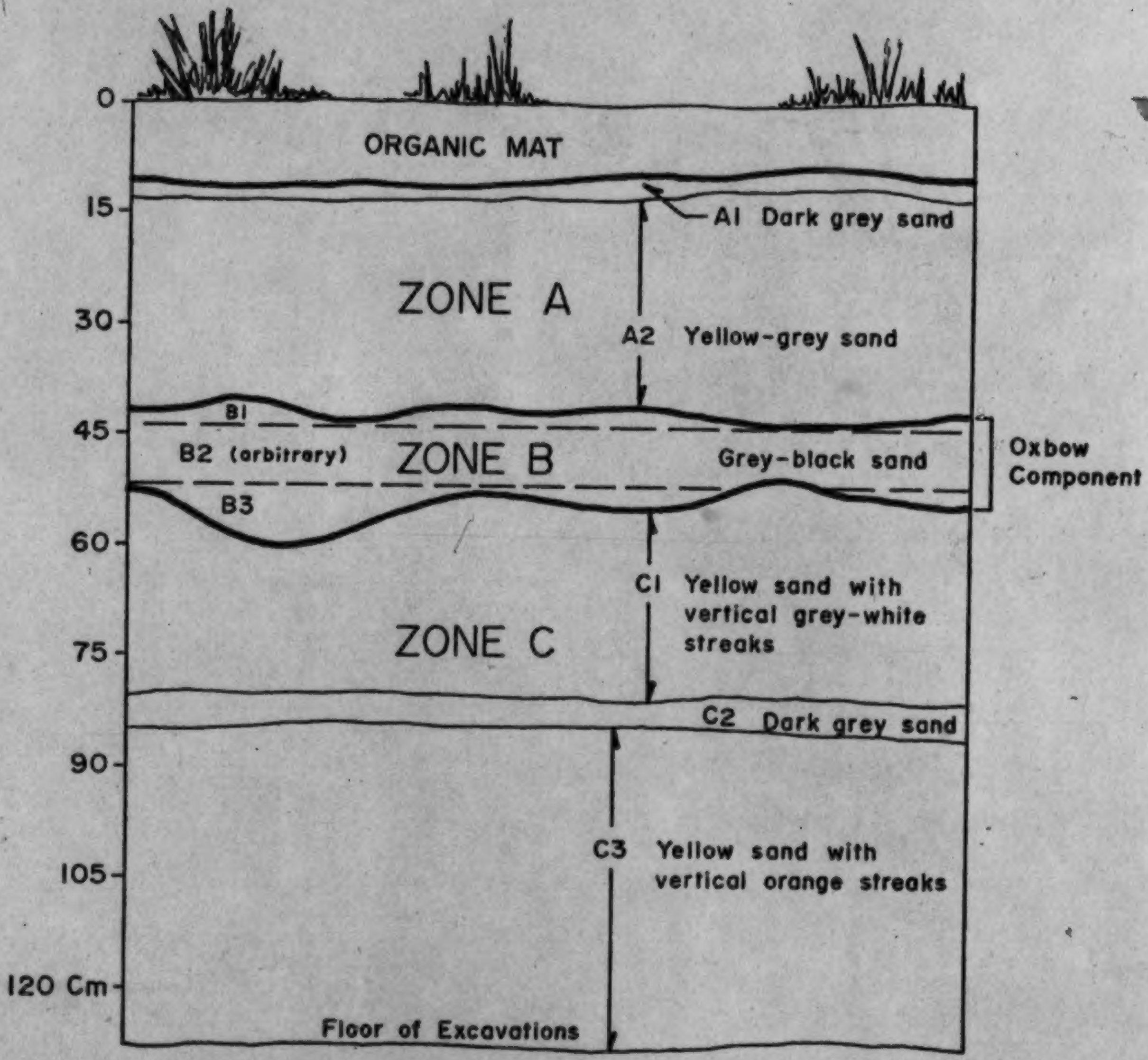

0
15
30
45
60
75
90
105
120 Cm
ORGANIC MAT
A1 Dark grey sand
ZONE A
A2 Yellow-grey sand
B1
B2 (arbitrary)
ZONE B
Grey-black sand
Oxbow Component
B3
C1 Yellow sand with vertical grey-white streaks
ZONE C
C2 Dark grey sand
C3 Yellow sand with vertical orange streaks
Floor of Excavations

Fig. 5 Stratigraphy at the Harder site.

black sand providing a trace of evidence for late prehistoric or early historic aboriginal occupation. Underlying the dark grey subzone, and sometimes immediately below organic matter, is the main body of Zone A, a yellow to yellow-grey sand in places mottled with dark grey sand. The bottom of Zone A conforms to the gently undulating surface of Zone B.

Zone B, comprised of grey-black fine textured sand, forms the matrix surrounding the Oxbow remains. The layer varies from 12 to 28 cm in thickness. The intensity of dark colour in Zone B is quite marked in some regions of the site, usually in coincidence with a concentration of occupation debris; but elsewhere the colour nearly disappears into the yellow of Zone A above and Zone C below with only bits of cultural material remaining to mark the position of Zone B. The bottom of Zone B generally fades through a fuzzy transition of 2 to 6 cm into Zone C. Throughout the site it appears that Zone B parallels the modern flat bottom basin profile. However, at the edges of the site and, coincidently, near the walls of the dune depression, Zone B fades and cultural materials diminish to nothing, making positive definition of the prehistoric surface profile extremely difficult. The centering of the Oxbow remains in the modern depression suggests the same depression may have been present in prehistoric times. Moreover, careful inspection of ditch profiles at both north and south edges of the site revealed that Zone B did bend upward at the base of the modern basin walls but less steeply than does the present surface profile.

Zone B, has been arbitrarily subdivided into subzones 1,2 and 3 in order to distinguish vertical distributions of occupation remains and micro chronology within the single Oxbow component (see p. 86).

Zone C, underlying the occupation, is a massive body of yellow sand consisting of three subzones. The top 75 cm of Zone C have been exposed, revealing the effects of surface water percolating downward and of ground water near the surface. A subzone (C1) with light grey sand dissolving in vertical streaks into yellow sand marks the beginning of Zone C. The light grey material appears to have been washed down from the occupation layer above. Subzone C1 is approximately 30 cm thick. Subzone C2 is a dark grey band approximately 10 cm thick with white vertical streaks penetrating through from the bottom of C1 and from the top of C3. The grey band and white streaks are both probably due to accumulation of salts, even though the grey band has the appearance of being a paleosol (D. Acton, pers. Comm.). Subzone 3 is a massive body of fine yellow sand with orange vertical streaks indicating the accumulation of iron throughout the 40 cm of the subzone that was observed (D. Acton, per. comm.). Field inspection shows no textural variation in the sand from the top of Zone A to the lowest observed portion of Zone C.

My interpretation of the soil strata at the Harder site starts at the bottom. Zone C is parent material consisting of fine aeolian sand of glacio-fluvial-lacustrine origin with residues deposited in it by ground water probably during modern times. Zone B represents the surface layer at the time of occupation, a layer greatly enriched by human activity. If an Ah horizon was present at the time of occupation, it has been severely leached toward the edges of the site and on the walls of the dune depression. Zone A is aeolian sand deposited into the dune depression by wind and perhaps supplemented with slope wash sands. Zone A was probably deposited soon after the site was abandoned as preservation of bone was good. Defoliation of parts of the local area by overgrazing or by fire could have exposed sand that was subsequently transported to Zone A in the Harder site. Above the modern Ah horizon on the top of Zone A and in the bottom of the organic mat is some charcoal which probably dates to the fire mentioned by surveyors in the early 1880s (see page 20).

EXCAVATIONS

History of Excavations

During June 1969, I discovered Harder site debris on the crown of the road. By inspecting the road shoulders, ditch bottoms and ditch profiles, I was able to determine that a site, some 60 m in diameter and comprised of pulverized bones, coarse broken rocks, many small chipped stone flakes, and a few chipped stone tools, was buried in black sand beneath the road and both east and west of it at a depth approximately 30 cm below the modern surface.

After several visits I found a small side-notched basally concave projectile point on the road indicating the site probably belonged to the Oxbow complex. Test excavations from 21 August to 3 September 1969 confirmed the stratigraphic position of the site and its single component nature, and exposed 17.7 m^2 of occupation surface allowing collection of chipped stone tools, chipped stone debris, butchered bones and broken rocks; but no features appeared. I named the site the Harder site after the family living near the excavations. Later, in the winter, I described the materials, dated them and analyzed them for information about prehistoric activities concluding that the Harder site had been a big game (bison, moose, deer) hunters' summer base camp (Dyck 1970).

I returned to the Harder site for parts of the next three summers, doubting some of my preliminary conclusions. During 1970 I excavated the first unit east of the road and two more units on the west side totalling 8.3 m^2 new exposure. Then, in 1971, I spent most of the summer at the site expanding the exposure to a combined total of 121.4^2 and adding 66.8 lineal meters of east-west profile trenches. Finally, in the fall of 1972, I returned for information about the southwest region of the site and exposed another 8.1 m^2, making an aggregate of 129.5 m^2 controlled exposure plus a complete north-south ditch profile and an essentially complete east-west trench profile (see Fig. 6).

Method

Details about stripping, troweling, recording, screening and collecting have been noted elsewhere (Dyck 1970:18-9, 1972:27) and need not be repeated here. However I do wish to comment on the placement of excavations. As soon as the approximate size of the site was determined, I realized that total excavation by a detailed recording method was ruled out. Therefore, considering the means at my disposal, I concluded that a mixed methodology comprised of extensive mechanical trenching and controlled manual exposure of approximately ten per cent of the occupation surface was both practical and adequate.

The horizontal extent of the site was determined by profiles that transected the occupation surface. North-south limits were obtained by simply observing the ditch profiles, particularly the west profile of the west ditch. The east-west limits were obtained by viewing the profiles of special backhoe trenches which I placed both east (see Plate 7) and west of the road on a line perpendicular to the road allowance and centered on the concentration of occupation debris seen in the north-south profile. In these profiles the section in which Zone B black colour and/or bone and stone disappeared was taken as the limit of the site in that region. Backfill was screened at 15 to 20 m intervals along trench and ditch profiles to test visual observations, and results were supportive. It appears that the site is bisected by the road and quartered by the east-west trenches.

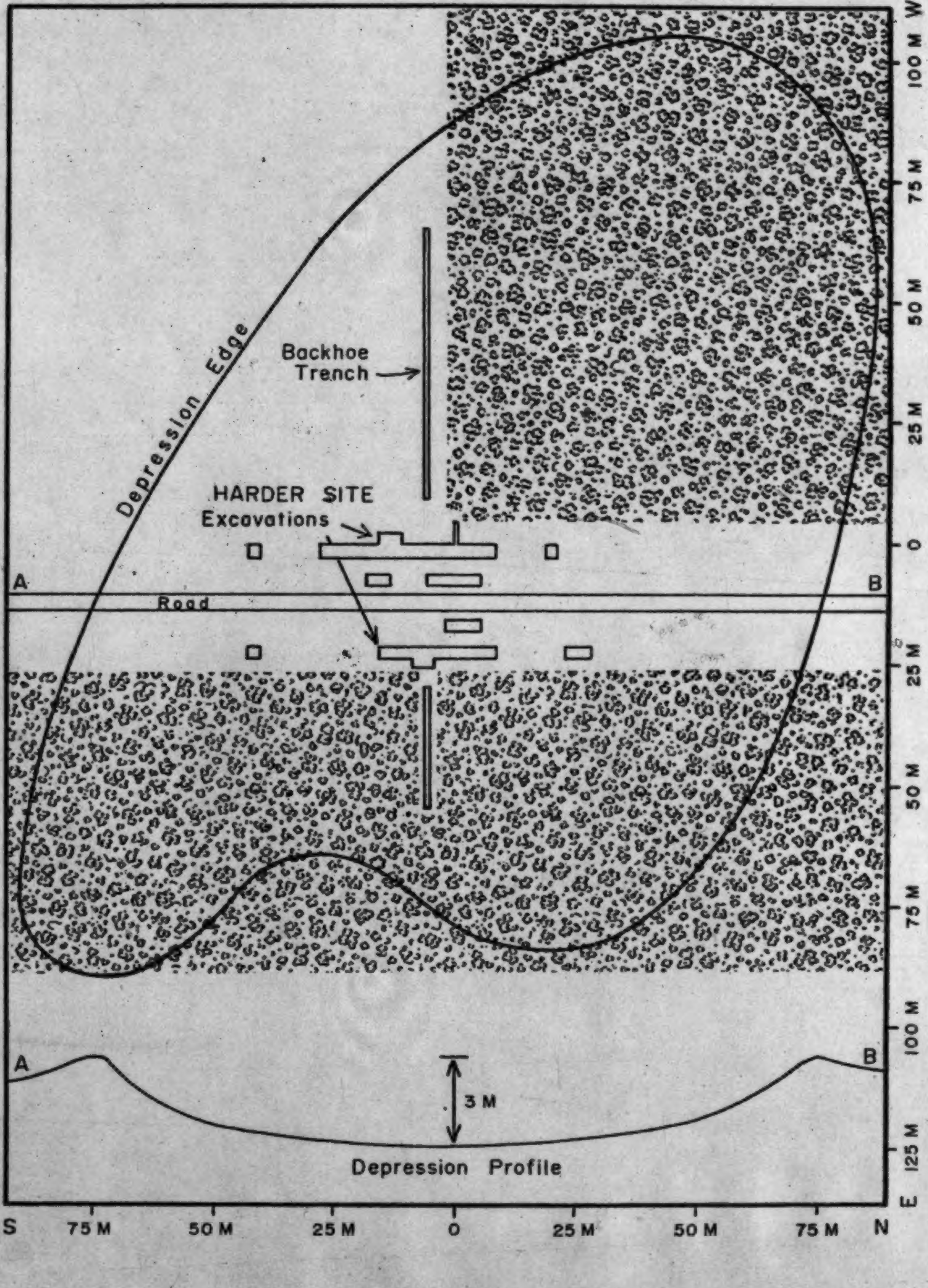

W
100 M
75 M
50 M
25 M
0
25 M
50 M
75 M
100 M
125 M
E
Depression Edge
Backhoe Trench
HARDER SITE Excavations
A
B
Road
Depression Profile
3 M
S
75 M
50 M
25 M
0
25 M
50 M
75 M
N

Fig. 6 Harder site excavations in relation to the road and dune depression.

Manual excavations were concentrated in the central area of the site with only single units in outlying regions (see Fig. 6 and Plate 8). The basic excavation unit was a 1.52m square. I wanted to have as much exposed at one time as possible in order to recognize large composite features, but weather and crew size allowed only seven or eight open units at a time. I tried different combinations of adjoining units including four-unit squares, three and two unit rectangles, and single units and found two unit rectangles gave the maximum exposure and exploration benefits for the minimum excavation commitment.

I considered the idea of dividing the site into uniform units and randomly selecting a 10% sample for excavation; but rejected the procedure because it would have yielded information about the kinds and total amounts of artifacts in the assemblage, but not the variation and distributional patterns across the site. As Binford (1972:130) has pointed out, "You might be able to get a representative sample of items by excavating random squares or a series of noncontiguous squares, but you cannot get a meaningful body of data regarding the character and distribution of features." Only large scale excavation of contiguous units will allow that. At the Harder site, excavations progressed from test pits to expanded test pits to large scale excavation of contiguous units.

With the boundaries of the site established by profiles and with certain concentrations and voids already located in the profiles, manual horizontal exposures were meant to transect the concentrations I could see and wherever possible connect them to one another. The excavations were aligned north-south in a broad band corresponding to the municipal road allowance. They were most extensive where profiles indicated the greatest concentrations of material, indications that sometimes proved quite misleading. By exploring all concentrations seen in north-south profiles and some of the intervening spaces a good transect of the site was obtained. The largest continuous exposure was on the west edge of the west ditch, spanning and connecting two large area features. Other contiguous units spanned single features or voids, while outlying units tested fringe areas. One small excavation in the southwest part of the site appears to be in the middle of a large area feature not immediately evident in the ditch profile.

HARDER SITE AGE

Two samples of charred comminuted bone were submitted to the Saskatchewan Research Council-National Museum of Canada radiocarbon dating laboratory, Saskatoon, for age assessment. The results were as follows:

Lab. No.	Location in Site	Material Dated	Radiocarbon Years B.P.	Radiocarbon Years B.C.
S-490	central hearth, LAF 1	collagen	3360±120	1410±120
S-668 (NMC-547)	north perimeter, LAF 1	collagen	3425±105	1475±105

There is no doubt about direct association between the radiocarbon samples and the Oxbow remains. Archaeologically, both samples should date the same occupation and the two dates should provide a check on each other. The closeness of mean values and the considerable overlap in ranges of variation suggest there is no significant difference between the two assessments (cf. Polach and Golson 1966:18-20). According to Michels (1973:161) bone collagen does not suffer from exchange phenomena and therefore can be expected to yield a reliable age. For purposes of independent assessment, however, it would be desirable to obtain a bone apapilt or charcoal date for the site at some future time.

The Harder site age is about 1000 years younger than the 3200 B.C. to

2500 B.C. range suggested by several other Oxbow component dates (cf. Reeves 1972: Table 4). However, a date of 4100±90 radiocarbon years 2150 B.C. (Dyck 1970) for the Moon Lake site brings the range some 400 years closer; and the even younger date, 3050±80 radiocarbon years:1100 B.C., recently obtained (A. Rutherford, personal communication) for the Carruthers site (Dyck 1972) pushes the range past the Harder site date. Thus, the Harder date can be taken as an indication of a much longer survival of the Oxbow complex than was previously suspected.

Neuman's (1967) review of radiocarbon dated components in the northern and central Great Plains supplies a broader perspective yet, indicating that a possible antecendent to chipped stone technology appeared about 6500 B.C. in the form of the Simonsen complex (McKusick 1964:56-64), and then the technological tradition disappeared about 1300 B.C. in the form of late McKean complex materials (see Syms 1969). I think that as data increase it will become more difficult, rather than less difficult, to separate regional and temporal variants comprising this long technological tradition due to overlap of one complex upon another.

FAUNAL REMAINS

INTRODUCTION

By far the most numerous and visible remains at the Harder site were bones. Bleached bones scattered along the shoulders of the road led to the discovery of the site, and later the excavated faunal component contributed much important data. For example, calculations on the horizontal extent of the site are based mainly on the distribution of faunal remains. Furthermore, features within the site relate closely to bones and fragments of bones. Analysis has answered the initial questions (1) what type of animals are represented, and (2) what type of site is this? It has also generated information relevant to prehistoric habitat and hunting, game preference, butchering, diet, duration of occupation, and number of people at the site.

Post-butchering deterioration of bone has been minimal. Both the dense and porous tissue retain virtually original strength. Articular surfaces and edges of ancient fractures are sharp and firm. Sand must have covered the site soon after abandonment because no evidence of weathering was found except for occasional _in situ_ breakage due to frost action after burial. Out of a total of 88 kg of bones from controlled excavations, approximately one-third or 27.7 kg could be identified to element, genus, and species. The remainder was broken beyond recognition and designated unidentifiable comminuted bone.

Methods

Dr. G. E. Lammers of the Manitoba Museum of Man and Nature identified body parts and species present after the first season of work (See Dyck 1970). In the absence of a comparative collection, some identifications were necessarily tentative. Reanalysis of the 1969 faunal material during the course of my analysis of subsequent collections (with the aid of a comparative collection) confirmed Dr. Lammer's positive identifications. However, his tentative moose, elk, and deer have (with the exception of one major tooth which is definitely Alces alces) been reassigned to Bison.

Reference material utilized in my faunal analysis included a comparative collection of small and large game animals of the northern Plains, and the books The Anatomy of Domestic Animals by Sisson and Grossman (1953), and Post-Cranial Skeletal Characteristics of Bison and Bos by Olsen (1960). Analysing one level bag at a time, I sorted bones into identifiable and unidentifiable piles; then characterized unidentifiable pieces as a group in terms of sizes of pieces, surface colour, and combined weight. Identifiable bones and pieces were sorted into large and small mammal categories, and identified to element and side. Species identification was made by comparison with the comparative collection.

For every identifiable piece a written record was kept of the portion of the element represented, the side, species, comparative size (e.g. one-third smaller, same as, or one-third larger than adult cow), and whether or not the epiphysis had fused. Occasional butchering marks, animal gnaw, and charring or staining were noted. Identified bones were tallied by species for each excavation unit and in turn units were tallied for the total number of each species in the excavated part of the site.

SPECIES AND PARTS PRESENT

Bison

Out of 847 identifiable pieces of bone, 735 belong to Bison bison. Moreover, since Bison appears to be the only big animal hunted by the Oxbow inhabitants at the site, it is reasonable to assume that all unidentifiable comminuted bone attributable to large animals, or at least 90% of the comminuted bones, was also Bison. Assignment to the modern taxon seems reasonable because all pieces complete enough for size comparison seem to fall within the range of modern comparative specimens.

Significance of incomplete skeletons. Archaeologists have utilized osteological observations to distinguish between camp sites and kill sites for some time (White 1952; McCorquodale 1960; Kehoe and Kehoe 1960). The distinction is based on the postulate that if camp and kill site are one and the same, then all parts of the animal skeleton should be found. Otherwise kill and camp sites should be distinguishable on the basis of presence or absence of certain regions of the skeleton. Hunters usually discarded bones containing little marrow or grease (skull, vertebrae, pelvis) at the kill site, but usually packed bones rich in marrow or grease (mandibles, humeri, radii, metacarpals, femora, tibiae and metatarsals) back to camp. Recently, Perkins and Daly (1968) derived an auxiliary hypothesis that "the larger the animal and the farther from the point of consumption it is killed, the fewer of its bones will get 'schlepped' back to the camp, village or other area". They named this phenomenon the 'schlepp effect'. In order to test for the schlepp effect at the Harder site detailed observations on presence or absence of skeletal elements were required.

Skull and mandibles. There were no complete Bison skulls or mandibles at the Harder site. Fragments of temporal bones (petrosals), upper cheek teeth occasionally associated with alveolar bone (maxillae), fragments of occipital condyles, a segment of horn core from the point of juncture with the frontal bone, and several unidentified skull segments could represent as few as three skulls. The largest segments of mandibles were mid-segments containing three or more molar and/or premolar teeth encased in alveolar bone extending medially and laterally downwards as far as the roots. All other regions of the mandible were also represented by smaller fragments and segments of bone, including symphyses, incisors, individual lower molars and premolars, ventral mid-segments, segments of ascending rami, condyles, and coronoid processes. A minimum of seven left and six right mandibles are indicated by these remains. Five segments of the greater cornu of hyoids were also present.

Spine and thorax. A minimum of three animals is represented by one complete atlas vertebra and two broken ones. Anterior articular surfaces were the only evidence for two axis vertebrae, but five specimens of the third to seventh cervical vertebrae survived somewhat more intact, some missing only the spinous process, others lacking the whole neural arch and extremities of the ventral branches of transverse processes. Third to seventh cervical vertebrae represent only one or possibly two animals. Four broken centra and four anterior articular facets from neural spines provide the only evidence for thoracic vertebrae in the site. Similarly, the thoracic cage seems conspicuous in near absence. I did not find any sternal elements. Three rib heads and 36 rib mid-sections may represent only one animal. The lumbar section of the spine was also lightly represented by six fragments including transverse processes and the posterior articular facets above the centrum. I did not find any sacral or caudal vertebrae. Except for atlas and axis fragments, all remains attributable to the spine and thorax could have come from one animal in fact, from part of one animal.

Front limbs. Front limbs include bones from scapula to metacarpal, but not phalanges (which are considered separately). Scapulae were represented by distal extremities and mid-segments of the blade, and indicate a minimal of four animals. Distal extremities usually included the whole glenoid cavity and about 2 cm of the shank. Mid-segments were mostly from the posterior border and/or scapular spine. Proximal ends of humeri were rare, only three head segments being identified, but distal ends were somewhat more common; a minimum of seven animals is postulated on the basis of humeri fragments. Many unidentified pieces are suspected to be shaft segments from large marrow bones such as humeri. Radii were identified by 10 proximal and 11 distal ends evenly divided between left and right sides giving a minimum of six animals. Very little shaft remains attached to any end. Ulnae were recognized primarily by the proximal articular notch and in two instances by approximately 3 cm of the distal end (not fused to the radius). In all cases the ulnar notch was detached from the main body of the ulna. A variety of essentially complete carpals from both sides represent 11 animals. Shafts had been broken out between the ends of all metacarpals but one. Sixteen proximal and distal ends of metacarpals suggest a minimum of six animals.

Hind limbs and pelvic girdle. The pelvis was lightly represented in the site. Most of 15 identified specimens comprise only part of the acetabular articular surface, but two whole acetabula and a few segments of ilial and ischial rami also appeared. A minimum of nine animals were represented by pelvic segments. Femora consisted mainly of head fragments and a few larger shaft mid-segments. No distal ends were recognized. Femoral fragments represent a minimum of four animals. Patellas and proximal ends of tibiae appeared in small numbers; five slightly broken patellas indicate a minimum of three animals and one large and one small fragment of proximal ends of tibiae indicating only a single animal. Only one segment of tibia shaft was identified, but many more must be present because distal ends of tibiae were the most numerous single element in the site. Seventeen left and 11 right distal ends of tibiae show a minimum of 17 animals in the excavated part of the site. Out of 105 tarsal bones I observed left and right sides to be evenly matched. In examining for presence or absence of certain tarsals, I again found fairly even overall representation with tibial tarsals (12 left, 13 right), fibular tarsals (13 left, 11 right), and central and fourth fused tarsals (9 left, 11 right), being slightly more numerous than the smaller elements. One observation about the breakage of tarsals was sufficiently frequent to seem patterned. About 50% of the fibular tarsals, the bodies of which jut backward and upward from the ankle providing attachment and leverage for flexor muscles, were broken across the base of the large slab-like process which articulates with the lateral malleolus. Both parts of broken fibular tarsals were found in excavations. The last bone in the hind limb before toe bones, the metatarsal, was recognized only by proximal and distal ends. In all cases the shaft had been smashed out. Thirteen proximal and 10 distal ends of metatarsals represent a minimum of seven animals. In comparing the front and hind limbs for breakage and numbers of elements present, I saw a fairly close similarity. In most cases hind limb elements outnumbered forward counterparts by only a small margin. Distal ends of left tibiae were about one-quarter more numerous than most other limb elements.

Phalanges and sesamoids. I did not attempt to distinguish between left and right, anterior and posterior phalanges or phalangeal sesamoids. I did note the position (first, second, third, proximal or distal), of each specimen. Some 61 first phalanges at the rate of two per foot, represent a minimum of eight animals. More than 30% of the first phalanges were split longitudinally (off centre usually) or chopped transversely (usually toward one end or the other). The two-thirds balance was intact. Proximal sesamoids, which articulate at the metatarsal-phalangeal joint at the rate of four per foot, 16 per animal, totalled 54 specimens indicating a minimum of four animals. Second phalanges were as numerous as first ones: 58 specimens indicate a minimum of eight animals. The rate of breakage, however, was noticeably less with about 85% of second phalanges surviving intact. Some 20 distal sesamoids at the rate of two per foot indicated a minimum of three animals. Several distal and proximal sesamoids were charred black and a few of each had been burned to a blue-white colour. It seemed remarkable that such small bones as phalangeal sesamoids would have been broken, but 33% of the distal ones had been snapped or chopped in two transversely. The third phalanx, core of the hoof, was about one-half as numerous as either first or second phalanges. Some 24 specimens indicate a minimum of three animals. If phalanges and sesamoids are considered as a unit, it is apparent that feet were very nearly as numerous as limbs. Regions of the bison skeleton represented by bones at the Harder site are diagrammed in Fig. 7.

The types and numbers of bison bone are shown in Table II and summarized in Fig. 8 in terms of percentage for each skeletal region. On the basis of presence or absence of bones from certain regions it is possible to determine what type of site this was. Skull remains were mainly mandibular and represent a minimum of seven animals. Mandibles contain some marrow and possess some potential as a chopping tool. They might be discarded at a kill site or they might be brought back to a camp, perhaps as a unit including the tongue and parts of the hyoids. The main part of the skull probably was left at the kill site either intact or broken. Parts of it,

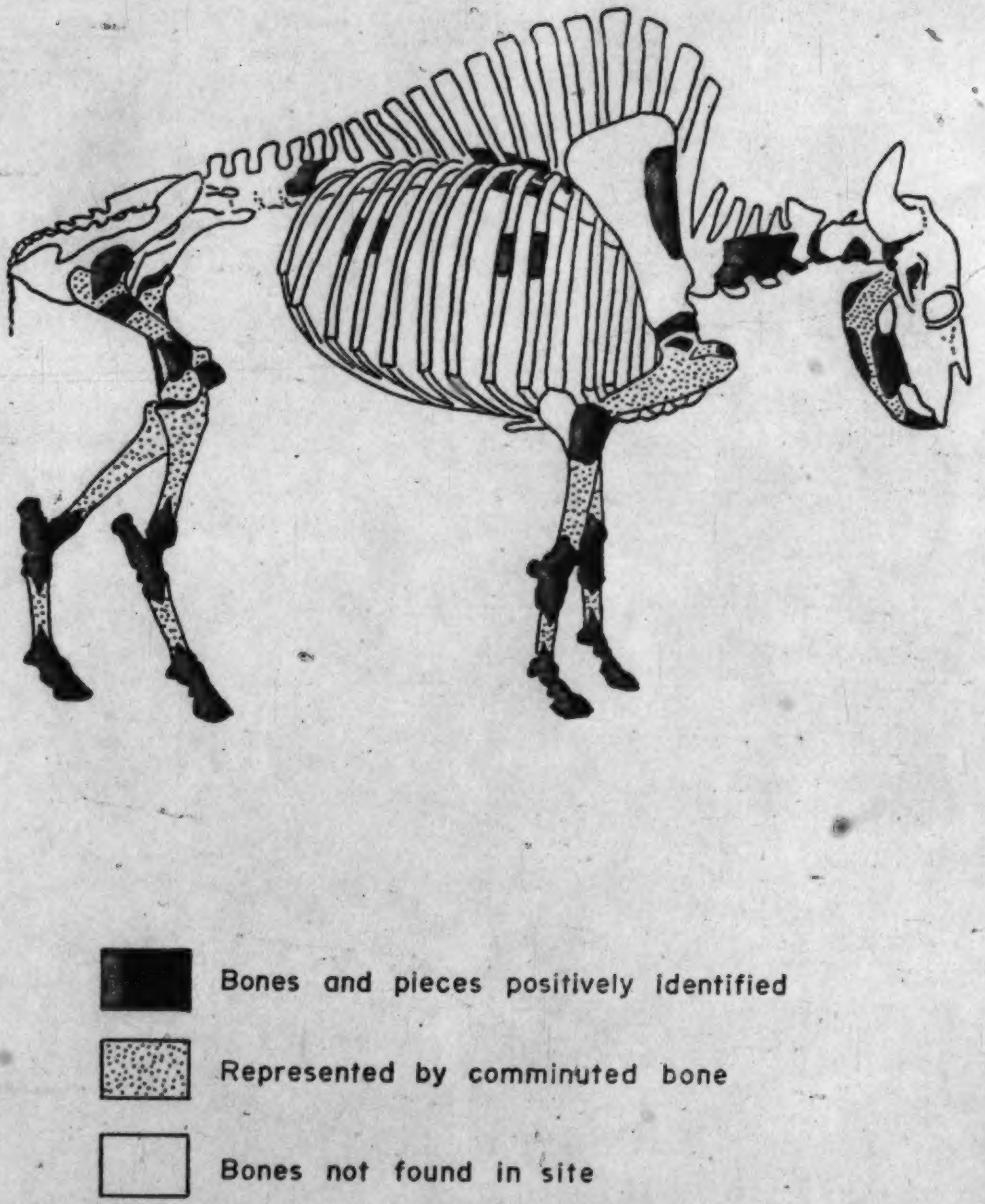

■ Bones and pieces positively identified
▨ Represented by comminuted bone
□ Bones not found in site

Fig. 7. Parts of Bison skeleton at the Harder Site.

TABLE II

IDENTIFIED FAUNAL REMAINS AT THE HARDER SITE

Element	Bison	Alces	Canis	Vulpes	Lepus	Martes?
Petrosal	10					
Skull, occupital condyle	4		1			
Horn core, frag	1					
Upper cheek teeth	22		4	1		
Lower cheek teeth	38	1	15			
Incisors	15		7			
Canines			5			
Candible, complete	0					
posterior region	14		5			
mid section	3+		3			
symphysis	5					
Hyoid, greater cornu	5					
Atlas, frag	3					
Axis, frag	2		1			
Other cervical vert.	5		1			
Thoracic vert. (centrum)	4					
Base of neural spine	4					
Lumbar vertebra	6		1			
Sacral vertebra	0					
Caudal vertebra	0					
Pelvis, acetabulum	15					
Rib, head	3		1			
mid section	36					
Sternum	0					
Scapula, blade frag	10					
distal end	7		1			
Humerus, proximal	3					
distal	10		5			
Radius, proximal	10		1			
distal	11		1	1		
Ulna, proximal	8		1			
distal	2					
All carpals	74		1			
Metacarpal, proximal	7		1			
distal	9		1			
Sesamoids, proximal	54		2			
distal	20					
Fermur, proximal	9		1	1		
distal	0			1		
Patella	5		1			
Tibia, proximal	2		1			
distal	28					
All tarsals	105		4			
Metatarsal, proximal	13		3			

TABLE II (cont.)

Element	Bison	Alces	Canis	Vulpes	Lepus	Martes?
distal	10		6			
All first phalanges	61		2			
All second phalanges	58		1			1
All third phalanges	24					
TOTALS	735	1	77	2	2	1

for example the nose-muzzle, might be chopped off and brought back to camp. Vertebrae were probably left at the kill site unless there were dogs to feed, and then some bones might be gathered up and taken to camp. There were very few vertebrae in the site. Heads of ribs probably were abandoned with the vertebral column at the kill site, but some rib mid-segments might be carried to the camp in slabs of rib meat. Rib heads were very rare in the site, while mid-segments of ribs were frequent. Depending on the method of field dressing, some bones might have been broken at the kill site for an immediate marrow feast, but most marrow bones were probably packed back to camp. In some cases upper limbs and encasing flesh may have been removed as a unit (hams). Upper limbs were solidly represented at the Harder site, followed by almost as many feet. For some reason feet were often chopped off and then carried to the processing area (cf. Frison 1973:51). In conclusion, bison bones at the Harder site were those that should be expected in a camp or meat processing situation.

Alces

Only one specimen, a lower right molar, was identified as Alces alces (moose). I was alert to the possible presence of Alces both by Lammer's

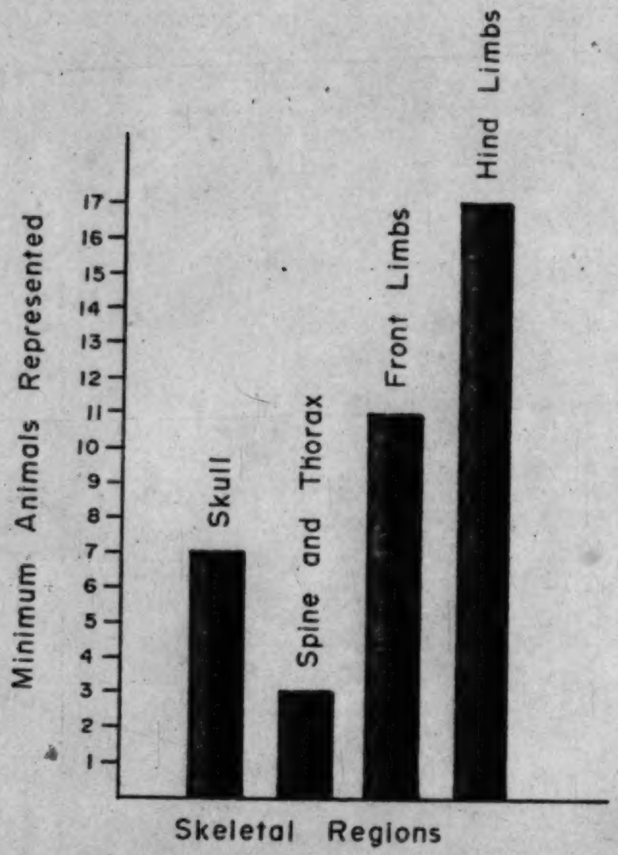


Fig. 8. Histogram showing representation of four regions of the bison skeleton at the Harder site.

1969 analysis and also by the parkland location of the site within the southern historic range of moose (Hall and Kelson 1959:1015). All specimens that were aberrant from the bison norm were carefully compared to known bison and moose specimens and to other species until identification was certain.

Canis

Aside from Bison, which dominates the collection, Canis was the only taxon showing more than a trace in the site. The 77 identified elements represent a minimum of four animals. More than 50% of the pieces (40) are skull parts, mostly teeth and mandibular bone segments. The breakage of mandibles and even teeth was considerable. None of the mandibles was complete; however, in one case the mandibular tooth row was intact (See Plate 9). Postdepositional breakage due to frost action was severe on the bone surrounding teeth, splitting it into small segments. Teeth were also cracked and split *in situ* as a result of frost action or desiccation. Cusps of larger teeth were moderately worn.

The spine and thorax are weakly represented by two neck vertebrae, one lumbar vertebra, and one rib head. Front limbs numbered 11 pieces representing all bones, including five distal ends of humeri, one of which had been gnawed by a sharp-toothed animal. Hind limbs produced 16 pieces, among which tarsals and metatarsals showed a slight predominance. Phalanges and sesamoids made up the balance with five pieces. The number of each element present is summarized in Table II.

The genus Canis includes three species which are potential contributors of the bones just described. Canis lupus (wolf), the largest of the three, was a numerous and constant companion of the buffalo (Richardson 1829:63).

Canis familiaris (dog), intermediate in size, was the Plains Indians' only domestic animal and main beast of burden prior to the horse. And *Canis latrans* (coyote or prairie wolf), smallest of the three is still present in the area, lives in smaller groups than wolves, and was very wary of man. The three species form an overlapping series in size, shape, colouring and behaviour. The question is, which species were at the Harder site?

John Richardson commented (1829:75) that the resemblance between wolves and dogs of those Indian nations still preserving their ancient mode of life was very remarkable. Elsewhere, referring specifically to the dog used by Indians in the Saskatchewan Rivers area, Richardson (1829:80-1) provided a good description and comparison, commenting that it was intermediate in size between Esquimaux and Hare Indian dogs, possibly derived from a cross between the prairie and gray wolves, with thick wooly fur of mainly black and gray colours mixed with white, with the sneaking habits but not the intelligence of the wolf, and with the habit of making deep holes in sandy ground during summer.

The external similarities between wolves (including coyotes) and dogs carry over to the bones. Anatomically, wolves and primitive dogs are very similar; an often confirmed fact, this sameness leads to difficulties in separating the species by bones. Some workers do not draw a distinction between the species; when they say dogs, they really mean wolves, domestic dogs, or coyotes (White 1955:172). Others make a claim for the presence of dogs on the basis of tooth wear. The argument is that the only animals that could survive with excessively worn teeth would be dogs, (fed by their masters); wolves with such teeth could not obtain enough food for survival (cf. Davis and Stallcop 1965:10; Frison 1967:23). This reasoning does not take into consideration that wolves are a co-operative species that hunt in packs. As long as a wolf could get to the kill and observed the etiquette of the wolf hierarchy, he probably got some meat. Consequently, it should not be too surprising to find animals surviving into wolf old-age with considerable wear on their teeth.

Over a period of time, interested workers (Clutton-Brock 1969:304-07) have discovered several distinctions that can be used to separate wolves and dogs: (1) in the wolf, the length of the upper carnassial tooth is greater than the combined length of the two upper molars, whereas in the dog the length of the carnassial is less than, or at the most equal to, the length of the two molars; (2) reduction in size of the carnassial teeth is typical of highly domesticated dogs, especially dogs of large body size; (3) primitive domestic dogs and even captive wolves show an overall reduction of size. In the skull this reduction is seen as a shortening of the jaw bones without a corresponding reduction in width, a development which produces a wide muzzle. In the shortened muzzle the teeth are compacted. It is common for the third upper premolar and fourth lower premolar to overlap the carnassial teeth that lie behind them. (This overlap should not be used alone as a definitive feature); (4) dog teeth, especially the canines and carnassials, are individually smaller than those of wolves; (5) in highly domesticated dogs the cusp pattern of teeth, particularly premolars, is reduced in complexity. The posterior accessory cusps may be much reduced in size or entirely absent; (6) periodontal disease (recognized by porous or spongy jaw bones, abscessed teeth or rotten teeth) can be taken as indicating the presence of domestic dogs feeding on a soft diet; (7) a collection of dogs show marked variability in tooth size in the same size mandible, while wolves' teeth are much less variable in size. A number of other tooth-tooth and tooth-mandible length ratios have been devised and used to distinguish between dog and wolf (Lawrence 1968; Lawrence and Bossert 1967).

In order to make a distinction between dog and wolf using the above criteria it is almost essential to have complete skulls and mandibles. Lacking complete specimens, one could still check for periodontal disease. None appeared at the Harder site, but I would not expect Oxbow people to be feeding dogs a soft diet anyway. The size of individual teeth turned out to be the only means available to separate the bones aside from general observations on robustness. According to Haag's (1948) osteometric analysis of recent and prehistoric aboriginal dogs from North America, the length of first lower carnassial molars falls into a range of 16.5 to 25.0 mm (n=246). Wolves' first lower carnassial molars overlaps with the upper end of the dog's range and extends upward beyond it. Three of the four first lower carnassial molars found in the Harder site were complete enough to allow measurement: measurements were 26.6 mm, 29.2 mm, and 30.2 mm; all greater than the upper limit for aboriginal dogs. Since all three measureable teeth were from right mandibles, I conclude that a minimum of three animals represented by canid remains were wolves. The robustness of some of the limbs in comparison to known wolf specimens appears to support this conclusion. The remains may not, however, be all wolf, because two metapodials much smaller than those of a wolf compare very favourably to the size of a coyote. Thus, the canid bones indicate the presence of _Canis lupus_ and _Canis latrans_, but do not rule out the presence of _Canis familiaris_ which might still have been at the site.

A fifth cervical _Bison_ vertebra, discovered in unit 0w20s, shows clear evidence of having been gnawed by a sharp-toothed animal (Plate 10). Both anterior and posterior centrum epiphyses were absent (unfused), indicating that the bison was immature at the time of its death. The neural arch above the centrum was intact except for the spinous process which was broken off at its base. The gnawing occurs on the underside of the vertebra where there was almost clear access to the centrum containing greasy tissue. Both central branches and both lateral branches of the transverse processes and the ventral spine were removed by gnawing. The animal stopped gnawing at a point approximately two-thirds of the way through the centrum when he began to penetrate the foramena transversarium. His teeth probably started to catch the holes, thereby interferring with his bite and since the bone was nearly exhausted for his purposes anyway, he abandoned it. I tested the vertebra against the biting action of skulls and mandibles of wolves, dogs, coyotes, and foxes to find the best fit. Dog and coyote were closest in size.

During historic times neck vertebrae were normally left in the field (presumably because of their relatively low marrow and grease content). Denig (1930:584) indicates that glands of the neck were one of the very few parts of the buffalo never eaten by the Assiniboines. Before the neck was abandoned, the flesh was cut away, but rejected because of its toughness (Wilson 1924: Fig. 83; pg 251). (Probably the purpose in cutting muscles off the neck was to obtain sinews extending along the sides of the neck vertebrae). The best explanation for the presence in camp of a few neck vertebra such as the gnawed one is that they were brought there by Oxbow people as dog food.

The historic record does not provide much elaboration on circumstances under which bison neck vertebrae were schlepped back to camp. Wilson (1924: 201) reports that "a man who killed a buffalo, saved the parts that he did not want for himself and gave them to the dogs". Wilson specifically mentions that the tough meat of the outside part of a buffalo's hams and parts of the leg below the knee were given to the dogs (pg 201-2). The day after the kill, left-overs became common property and anyone who wished meat (or bones) for his dog could go to the place where the carcasses were butchered and get the cast-away pieces (Wilson 1924:202). In the absence of preferred dog food cuts, neck meat and vertebra would be an obvious second choice.

The canid evidence, then, is that wolf and coyote carcasses were present in the site and that live dogs probably were also there.

Vulpes, Lepus and Martes

Small animals appeared as just a trace in the faunal remains. *Vulpes velox* (swift fox) was identified from an upper right second molar and the distal end of a radius. *Lepus townsendii* (prairie hare or white-tailed Jack rabbit) form matching proximal and distal ends of a femur. One complete second phalanx was tentatively identified as *Martes americana* (marten). The means of determining whether these animals were killed by Oxbow people, or by wolves which in turn were themselves killed and brought into camp, is not at hand.

Unidentified Bones

Some 27 small pieces, most of them small broken elements could not be identified. As a guess, the majority were from small rodents such as ground squirrels or mice. A few of the elements were blackened as if they had been charred by fire, a fact which may indicate that they were contemporaneous with the occupation of the site.

Human Teeth

Two very worn teeth are believed to be human. One had a single root resembling an incisor; the other had a double root and resembles a premolar. In both cases the crown is nearly worn away leaving only a small collar of enamel around the edge of the occlusal surface.

Distribution of Bones

Bones were well scattered and did not include any articulated arrangements. Six large general concentrations of bone, five small piles of fragments, and two small pockets of pulverized calcined bones were found in excavations (See Appendix I and Plates 11-16).

MINIMUM NUMBER OF ANIMALS IN EXCAVATIONS

The minimum number of animals in the excavations, calculated by the most numerous element method (Kehoe 1967:65), is shown in Table III. For Bison the four highest element counts are given to show which parts of the body are best represented and for a statistical summary to be used in later calculations. For the balance of the animals only the single most numerous element is shown.

TOTAL NUMBER OF BISON IN THE SITE

An estimate of the total number of bison in the Harder site is important for two reasons. First, from such a number (in conjunction with certain other evidence) one can infer the range of hunting techniques possibly used. For example, in order to kill a large number of bison in a single locality hunters would probably organize a communal operation such as a pound or surround. On the other hand, if only a few animals were desired or available small groups or even individual hunters might have stalked the animals one at a time. Secondly, by utilizing historic rates of meat consumption/preservation in conjunction with estimates of

TABLE 111

MINIMUM NUMBERS OF ANIMALS REPRESENTED BY BONES EXCAVATED AT THE HARDER SITE

Species	Minimum Number	Most Numerous Element
Bison bison	17	distal end left tibia
	(13)	left fibular tarsal
	(13)	right tibial tarsal
	(12)	left tibial tarsal
Alces alces	1	lower right molar
Canis lupus	4	lower right 3rd premolar
Canis latrans	1	proximal end metacarpal
Vulpes velox	1	upper right 2nd molar
Lepus townsendii	1	proximal end left femur
Martes americana (?)	1	middle phalanx

the numbers of humans and dogs present (derived from independent data) and an estimate of the total number of bison in the site, one can calculate the minimum time of site occupation.

Since the sample is fairly large (10%) and the horizontal dimensions of the site are known, the number of bison in excavations can be extrapolated to a total number for the whole site with reasonable confidence. The maximum east-west dimension of the site was 76.2 m (between 130 West and 120 East); the maximum north-south dimension was 54.9 m (between 60 North and approximately 120 South). These dimensions describe an area including both a central core where concentrations of material comprising the large area features were found and also a fringe of sparser remains surrounding the core. For the following calculation of area only the central core is included so that the estimate of total number of bison would tend to be minimal. The core area extended from 35 West to 85 West and from 15 North to 110 South giving dimensions of 36.6 m and 38.1 m respectively. Assuming a circular shape, the area of the core (hereafter referred to as the area of the site) is 1051 square meters. The first method for calculating total number of bison in the site depends heavily upon this statistic.

Calculations of the Total Number of Bison in the Site

Method 1. Total area times the average number of bison per unit area.

The crucial figures for this method of calculation are at hand. The total site area is 1051 square m. The average number of bison per unit area can be calculated by dividing the minimum number of bison collected in excavations (17 bison) by the total area of controlled excavations (129.5 square m). The final calculation is:

$$\text{Total Bison} = 1051 \text{ sq. m in the site} \times \frac{17 \text{ bison in the excavations}}{129.5 \text{ sq. m in the excavations}}$$

$$= 138 \text{ bison in the site.}$$

The assumption basic to this calculation is that density of bison bones in the whole core area was the same as in the area excavated. Although excavations did probe areas of the core where materials were sparse, there was a tendency to expand excavations in areas of greatest concentration and to abandon them in sparse areas. Probably, then, the average figure derived from excavations is too high for the whole core area, and the total number of bison calculated by it is also too high.

Method 2. Average number of Bison per Large Area Feature times the number of Large Area Features in the site.

The figures required by the second method must be developed out of data collected during excavations. The first statistic, average number of bison per Large Area Feature, can be calculated by determining the number of bison in each of the Large areas which have been sufficiently excavated to allow extrapolation of feature size (in this case LAFs I and IV meet the criteria), and by averaging the totals.

Total Number of Bison in Large Area Feature I

Given: The area comprises a circle approximately 6.1 m in diameter (from the centre of Bone Pile I to the north edge of Bone Pile II), plus the area of Bone Pile II which is estimated at 3.71 sq. m.
The number of bison collected from the excavated portion of this feature is nine (based on the count of the most numerous single element which was nine left distal ends of tibae).
The portion of this feature excavated is 20 sq. m.

Calculation:

$$\text{Total Area} = \pi r^2 + 3.71 \text{ sq. m} = \frac{22}{7} \times (3.05\text{m})^2 + 3.71 \text{ sq. m}$$

$$= 32.9 \text{ sq. m}$$

$$\text{Total Bison} = 32.9 \text{ sq. m} \times \frac{9 \text{ bison}}{20 \text{ sq. m}}$$

$$= 15 \text{ bison } [14.8 \text{ bison}]$$

Total Number of Bison in Large Area Feature IV

Given: The area comprises a circle approximately 4.3 m in diameter (based on the semicircular concentration in excavation units 42e0n and 42e5n), plus a hypothetical attached bone pile with an area of 3.71 sq. m.
The number of bison collected from the excavated portion of this feature is four (based on the count of four left distal ends of tibae).
The portion of the feature excavated is 4.65 sq. m.

Calculation:

$$\text{Total Area} = \pi r^2 + 3.71 \text{ sq. m} = \frac{22}{7} (2.2\text{m})^2 + 3.71 \text{ sq. m}$$

$$= 18.9 \text{ sq. m}$$

$$\text{Total Bison} = 18.9 \text{ sq. m} \times \frac{4 \text{ bison}}{4.65 \text{ sq. m}}$$

$$= 16 \text{ bison } [16.3 \text{ bison}]$$

Average Number of Bison for Large Area Features I and IV

$$\text{Calculation: Average No. Bison} = \frac{\text{Total Bison LAF I} + \text{Total Bison LAF IV}}{2}$$

$$= 15.5 \text{ Bison per LAF}$$

The second statistic, the total number of large area features in the site, is a matter of field observation. Four Large Area Features were exposed during the course of controlled excavations in the site. In addition to those four, two others of similar size and thickness could be seen in the deep east-west trenches (one in the west trench located about 3 m southwest of LAF I; one in the east trench located about 4 m southeast of LAF IV). Given that these slightly exposed concentrations were also LAFs, the observed total of LAFs in the core area of the Harder site was six. Only that part of the LAFs corresponding to dwelling floors and associated refuse areas (See Chapter VI) are included in the calculation in order to keep the units comparable.

The second method of calculation is as follows:

$$\text{Calculation: Total Bison} = \overline{X} \text{ No. bison/LAF} \times \text{No. LAFs in the site}$$

$$= 15.5 \text{ bison/LAF} \times 6 \text{ LAFs in site}$$

$$= 93 \text{ bison in the site}$$

The assumpations basic to this method of calculation are that (1) the number of LAFs observed is the same as the true number of LAFs in the whole site, and (2) that the number of bison represented in the dwelling floor area plus the one general garbage dump associated with each dwelling floor is an accurate representation of the whole large area feature. If these two assumptions hold, then Method 2 should be valid for calculating the total number of bison in the site. If the assumptions are in error they likely will underrepresent the true situation: for example, it is more likely that, having used a minimal definition of LAF in calculating the number of bison per LAF, I have estimated too few bison per LAF rather than too many. Consequently, if the basic assumptions are in error, the method will tend to underestimate the total number of bison in the site. This tendency toward underestimation makes Method 2 an excellent compliment to Method 1 which, if in error, tends to overestimate the total for the site. Using the two methods together, upper and lower limits for the total number of bison in the site become 138 (maximum) and 93 (minimum).

TOTAL NUMBERS OF OTHER ANIMALS IN THE SITE

Non-bison remains showing only a trace, in most cases only one element, have been counted as one animal. The only non-bison which showed more than a trace, with a total of four individuals, was wolf. Using the same figures for total site area and for excavated area as for bison, and using Method 1 for calculation, the total number of wolves in the site was 33.

PROBABLE BISON HUNTING METHOD

Considering the rather large number of bison at the Harder site and assuming that remains represent one continuous occupation, it would seem probable that the hunting technique involved a communal affair such as a pound or a pedestrian version of the surround. Individual hunting might tend to disperse bison; and the effort needed to bring a large number of individual carcasses into a base camp from scattered kills seems prohibitive. Moreover, individual hunting would seem likely to produce a wider variety of animals than the single species dominating the Harder collection.

Out of communal hunting methods known for the Northern Plains (See Arthur 1974), pounding seems best suited to a large number of bison kills in the vicinity of one camp site. Pounding was a harvesting technique as well as a mass kill technique. A pound could be operated over a period of several weeks by a small camp of from 30 to 60 people, producing bison kills at a rate people could process easily, without transportation problems, and with minor disturbance to the victim. It should also be noted that the situation of the Harder site, at the edge of a wooded area near open grasslands, would have been ideal for a parkland pound.

A possible pound site was located during late field investigations in the bottom of a dune depression some 200 m west-south-west of the Harder site. Two Oxbow projectile points were found among a concentration of large bone fragments on the cultivated surface of the depression and this material may be traces of the upper part of a buried site. Unfortunately, excavations at this location were not possible.

MEAT CONSUMPTION AND THE LENGTH OF OCCUPATION

By utilizing estimates for total bison together with total numbers of people and dogs at the site and their rates of consumption of fresh meat, and by making assumptions about amounts of usable meat obtained from each bison and proportions of meat consumed fresh and meat preserved, it is possible to calculate the number of days for the camp to consume the fresh meat available. The number of fresh meat days, thus calculated, may be considered a minimum estimate of the length of Harder site occupation. By adjusting one variable at a time, several estimates may be obtained giving a range of time. Variables, assumptions, and the bases for them together with the method of calculation follow below. The results are shown in Table IV.

Variables and Assumptions	Basis of Estimate or Assumption
1. Total of bison was 93 to 138.	- see above p. 72.
2. Average usable meat per bison was 181 kg.	- by arbitrarily assigning the average weight of usable meat for adult female bison (Wheat 1972:114) as the overall average at the Harder site, in the absence of specific age and sex information.
3. Total people was 42 to 56.	- by assuming seven people per dwelling floor (per LAF) (derived from Palliser 1968:251-52); assuming six to eight dwelling floors at the Harder site.
4. Total dogs was 30 to 40.	- speculation based on estimate of five dogs per LAF and six to eight LAFs in the site.
5. Each person ate 4.5 kg fresh meat per day.	- Wheat 1972:121.
6. Each dog ate 3.6 kg fresh meat per day.	- Wheat 1972:121.
7. Assuming maximum utilization of available meat.	- indications of heavy butchering (Wissler quoted in Wheat 1972:100) throughout Harder site.
8. Assuming 50% of meat consumed fresh and 50% preserved.	- speculation; indications of intense comminution of bone, hence intensive bone production and meat preservation.

Method of Calculation

$$\text{DAYS OF FRESH MEAT CONSUMPTION} = \frac{\text{TOTAL FRESH MEAT CONSUMED}}{\text{DAILY CONSUMPTION OF FRESH MEAT}}$$

$$= \frac{1/2\ (\text{Total usable meat available})\ \text{kg}}{\text{Total people} \times 4.5\ \text{kg/day}) + (\text{Total dogs} \times 3.6\ \text{kg/day})}$$

Thus, the time required for consumption of fresh meat may be calculated to have been in the range of 21 to 42 days, an interval which, in the light of historic literature, seems a reasonable length of occupation for a bison hunter's camp in the Northern Plains (See for example, Cocking 1908:108-12).

PREHISTORIC HABITAT

If it is assumed that adaptations of wild animals have not changed greatly from Oxbow occupation until the recent historic period, then some general conclusions about environment (particularly vegetation) around the site can be drawn from the animal remains in it (See Appendix II for a review of the ecology of relevant species).

Each species recovered from the site covers such a broad range of territory that, singly they are ambiguous in reflecting the environment. The bison suggests plains, or parklands (with a slight possibility also of forests); the coyote suggest boreal forest, aspen parkland, or short-grass plains; the swift fox indicates arid short grass plains; the wolf could indicate boreal forest, aspen parkland, or plains, but in association with buffalo the wolf probably can be given somewhat greater weight as an indicator of plains or parkland; the prairie hare indicates short-grass

TABLE IV

CALCULATIONS OF FRESH MEAT DAYS

People	Dogs	kgs Fresh Meat	Consumption Days
42	30	8417	28
42	30	12489	42
56	40	8417	21
56	40	12489	32

sagebrush plains or an open parkland; the marten indicates coniferous forest or parkland; and the moose suggests boreal forest or parkland. The common denominator is parkland. It should be noted that animals representing both forest edge (moose, marten) and plains edge (prairie hare, swift fox) are present. If the camp had been situated approximately in the middle of a parkland belt (as the Harder site is today) this collection of game is what should be expected.

GAME PREFERENCE

There are several aspects to game preference. I will consider what animals were successfully hunted; what other game animals were probably available; and reasons for selectivity. Beginning with animals successfully hunted, I have already noted that in the area excavated there were a minimum of 17 bison, one moose, four wolves, one coyote, one swift fox, one jack rabbit, and one marten. Bison was obviously the main target of Oxbow hunters in this camp, with wolves in distant second place. As in historic times, bison no doubt answered most of the basic needs of the hunting group while wolves always being near the bison herds, supplied a convenient source of furs for winter clothing and a little variation to the usual buffalo meat diet.

It seems certain that bison in the Harder site represent a successful hunt rather than other imaginable situations such as human scavenging of an accidental mass death. The presence of stone projectile points indicates hunting activities had been carried out and the schlepp effect observed on bones indicates the kill was elsewhere. I assume that the wolves were also purposely killed and carried to the site. This may not, however, be true of the other animals which could just as well have been killed by wolves which in turn were killed by men. If the wolves had been carried back whole, then the moose, coyote, swift fox, jack rabbit, and marten bones might have arrived in camp as the stomach contents of wolves. A method for distinguishing between human and animal kills would include consideration of bone types present and inspection for butchering. No cut marks were observed on non-bison remains; one canid humerus showed gnaw marks but this could have happened after human use of the bone. The moose and swift fox teeth do not seem to be the type of bones that wolves would eat, but knowledge of wolf bone-eating habits is not at hand.

This particular collection of animals, whether killed by man or animals, suggests a parkland community around the Harder site. Assuming similar animals occupied the parkland in Oxbow times as in historic times, available game animals probably included those listed below. Ethnographic records show that Plains Cree (Mandelbaum 1940:198-99) and Assiniboine (Denig 1930:583) ate most of the animals, although some more often than others.

Given the wide range of game potentially available, one wonders why

Oxbow hunters concentrated on bison and wolf. One answer is chance. Buffaloes and wolves were simply the first animals the hunters encountered. Another time hunters might as easily have taken other species crossing their path. No doubt there is an element of chance in any hunting system. Generally, the amount of chance involved would seem to be inversely related to the hunters' (a) knowledge of and (b) control over the systems preyed upon. If the Oxbow hunter relied heavily upon chance, taking whatever came his way, then it should be possible to determine this by finding, in a large sample of Oxbow sites, not only a complete sample of the available game, but also a close indication of the relative abundance of each species parallel to the abundance expected in a wild state. The same large sample of sites might, on the other hand, show a consistent absence or lower than expected number of some species explainable by hunter preferences.

Game Animals of the Parklands - after Bird (1961)

*bison
wapiti
*moose
mule deer
antelope
grizzly bear
black bear
cougar
*wolf
*coyote
*swift fox
red fox
lynx
wolverine
badger
weasels
*rabbits and hares
mice
ground squirrels
beaver
muskrat
porcupine
skunk
raccoon
mink
*marten
fisher
otter
ducks
geese
cranes
prairie chickens
crows and magpies
hawks - not eaten
eagles - not eaten
owls
pelicans
small birds
snakes
turtles

Note: * refers to animals found at the Harder site

Another line of inquiry would be to examine the general game preferences known for the area during the early historic period to see what similarities and differences there are. During the mid 1700s, in the absence of bison, Anthony Hendry's Indian companions hunted wapiti and moose as they passed by the elbow of the North Saskatchewan (See Appendix II). Speaking of the Assiniboine Indians in 1776, some of whom may have been among the 24 tents of Asinepoets who treated Anthony Hendry and his friends to plenty of moose and beaver flesh at Eagle Creek 22 years earlier, Alexander Henry (1969:317-18) says:

> The wild ox alone supplies them with every thing which they are accustomed to want. ...The amazing numbers of these animals prevent all fear of want; a fear which is incessantly present to the Indians of the north.

Henry made this statement while watching Assiniboine Indians trade bits and pieces of their produce for trinkets. He was impressed (or perhaps depressed) by their ability to survive prosperously and yet independently of the fur trade. I assume Henry was aware that there were vacillations in the presence/abundance of buffaloes, during which other game was hunted; and that his words 'wild ox alone' only emphasizes the Indians' ability to subsist on the bounty of the land without the trader.

The Indian's concentration of buffalo and avoidance of fur animals was a problem often remarked upon. Alexander Henry (the Younger), while living at Fort Vermilion in 1809, noticed during both fall and winter that many Indians tended to drift downstream toward the elbow of the North Saskatchewan where buffalo were plentiful.

> Oct. 2 (1809)... The other 60 tents are gone down toward the Red Berry hills, where they will pass the winter eating buffalo, and not kill a good skin the whole season. (Henry 1965:548-49)

> Jan. 20th. (1810) ...when once they take the route for the pounds below, we expect no more fur from them during the season, as they idle, playing and eating buffalo. (Henry 1965:580)

In reference to the Bloods and Blackfoot, Henry again notes a lack of diligence in the collection of furs wanted by the traders. These Indians put priority on other animals which Henry named.

> The country they inhabit abounds with animals of various kinds; beaver are numerous, but they will not hunt them with any spirit, so that their principal produce is dried provisions, buffalo robes, wolves, foxes, and other meadow skins, and furs of little value. (Henry 1965:529-30)

In the parkland belt along the Rocky Mountains, the Piegans like their confederates, placed highest priority on bison, wolves and foxes.

> ...along the foot of the Rocky mountains, on Bow River, and even as far S. as the Missouri. The buffalo regulates their movements over this vast extend of prairie throughout the year, as they must keep near these animals to obtain food. In summer they are obliged to assemble in large camps of from 100 to 200 tents, the better to defend themselves from enemies. In winter, when there is not so much danger, they disperse in small camps of 10 to 20 tents, make pounds for buffalo, and hunt wolves and kits [Vulpes velox] (Henry 1965:723)

Even if there were an abundance of other game available, the Blackfoot tended to prefer to hunt buffalo.

> Game of all kinds abounded in the river-bottoms and foothills; elk, deer, antelope; often seen in bands of many hundreds; not much hunted by the Blackfeet, as they had abundance of buffalo.... (Denny MS., quoted in Roe 1951:867)

Writing about the parkland on the other side of the plains, along the Assiniboine River, David Thompson noted a wider range of big game utilized by Cree (Nahathaway) Indians. Upon close examination it seems Thompson meant to imply that these animals were utilized, not just available.

> The River everywhere flows thro' a pleasant country of good soil, and in time to come will no doubt, be covered with agricultural population; The Bison, the Moose and the Red Deer with two species of Antelope, give to the Nahathaway Indians, an easy subsistence. (Thompson 1916:208)

Thompson's narrative, written after 1840, was based on his journals and experiences in the West during 1786-1812 and on other information collected after retirement. His comments carry considerable weight of experience. At first it appears that he is at variance with his contemporary Alexander

Henry (the Younger) in suggesting a wider range of game utilization than just bison, wolves and foxes. And yet Thompson's range is not nearly so wide as that recorded by later ethnographers of the Northern Plains and parklands (e.g. Denig 1930; Mandelbaum 1940). I think the answer to the apparent difference between Henry and Thompson is that the former emphasized the selections most often made, while the latter named the components that held the most potential for hunting subsistence. It should be noted that the order in which Thompson listed the animals had bison first, moose and wapiti second and third, and two species of antelope (deer) fourth. (Thompson probably meant two species of deer, meaning mule deer, Odocoileus hemionus, and Virginia white-tailed deer, Odocoileus virginianus dacotensis, instead of two species of antelope.) This order fits well both with Henry's emphasis on bison and also with Anthony Hendry's record of moose and wapiti hunting in the absence of bison while travelling along the North Saskatchewan River. Historic records of antelope and deer hunting are rarer.

It is concluded that during early historic times Indians in the northern Plains and Parklands hunted and ate nearly all animals and birds available, but showed a marked preference for bison and wolves, moose and wapiti being a readily accepted second choice, and a wide variety of smaller game serving as a continuing complement to the main diet.

If bison hunting was going on, wolf hunting could very easily take place as an adjunct. One wonders, however, why the bison was first choice over all the other animals. Many writers have described how fully the bison carcass served the purposes of the Indian. However, we should not draw the conclusion that these were the only animals that could fulfil those needs. Surely moose, wapiti, antelope, deer, or bear could answer the same needs. Why then bison first?

Denig (1930:504) believed that the Assiniboines were not very good at hunting animals other than bison.

> Whenever the buffalo are plenty they have no difficulty in procuring more meat than they can use and then do dry some, but they are very improvident and their small supplies are soon exhausted. ...None of these nations except the Cree are good elk and deer hunters, consequently their whole dependence is on the buffalo, which as we have stated is precarious.

But the Cree denied proficiency in non-buffalo hunting. Fine-day, one of Mandelbaum's Cree informants put it this way: "We depended mostly on the buffalo. This was because anyone could kill a buffalo but it took a good hunter to get moose or elk." (Mandelbaum 1940:198). Mandelbaum goes on to elaborate that while many moose and elk were available, they were not hunted extensively because the lavish supply of buffalo made for a neglect of forest hunting techniques, and because moose and elk were best taken by lone hunters or by small parties and men were loath to leave the larger encampments. It is concluded that all prairie and parkland nations concentrated on buffalo hunting, and the usual explanation was that buffalo were easier to hunt.

One might ask why buffalo were easier to hunt. No full inquiry is attempted here. The habits of animals were known well to Indians and were vital in the choice of hunting techniques, but I will avoid the subject of animal habits and turn directly to subsistence economics and specifically animal numbers and weights. Table V gives the average live weight (for males and females) and the average density (in number of animals per square mile) of the major mammals in the Parklands. The weight indicates the amount of produce that could be collected for each animal killed, and the density indicates how often one would likely run into such animals. According to live weights bison is heaviest, followed by moose, wapiti, grizzly bear, black bear, mule deer, cougar, antelope, and wolf. These may be called

TABLE V

THE AVERAGE LIVE WEIGHT AND DENSITY OF PARKLAND MAMMALS

Animal	Live Weight (kg)		Source	Number per square mile
	m	f		
bison	817	less	Seton 1929	26
	681	363	Henry 1965; Denig 1930	18
	570	420	Banfield 1974	--
wapiti	318	227	Seton 1929	4
	315	225	Banfield 1974	20-30
moose	499	less	Seton 1929	1
	453	350	Banfield 1974	2-10
antelope	45	less	Seton 1929	20
	51	42	Banfield 1974	--
mule deer	114	68	Seton 1929	5
	50-215	32-72	Banfield 1974	--
grizzly bear	136-536		"	--
black bear	169	136	"	0.2
cougar	67-103	36-60	"	0.03
wolf	26-79		"	0.1
coyote	13		"	--
swift fox	2	1.9	"	0.5
red fox	3.6-6.8		"	0.6
lynx	11	9	"	0.17
wolverine	15	11	"	rare
badger	3.6-11.4		"	--
weasels	.1	.3	"	0.06
rabbits & hares	.9	3.4	"	10-20
mice	.07		"	5700-17100
ground squirrels	.49		"	3200
beaver	20		"	--
muskrat	1.1	1.1	"	3-35/water acre
porcupine	6.4			6-8
skunk	1.7	1.3	"	13.5
racoon	8.6	7.5	"	10
mink	2.1	.9	"	8.5-22
marten	1.0	.7	"	1-4
fisher	3.7	2.1	"	0.02
otter	7.8	7.2	"	0.6/river bank mi.

heavy animals - they weigh between 817 kg (bison) and about 40 kg (wolf). Middle weight animals, weighing between 39 kg and 4 kg, are, in descending order, beaver, wolverine, coyote, lynx, raccoon, otter, badger, porcupine, and red fox. Light weight animals, between 3.9 kg and 0.07 kg, are fisher, rabbits and hares, swift fox, mink, skunk, muskrat, marten, ground squirrels, weasels, and mice, again in descending order of weight. In terms of maximum return from minimum kills, it is clear that bison, moose, and wapiti are the logical first three choices.

Parkland mammals can also be classified by density. The heavy density class includes the lofty number of 17100 animals per square mile at one extremity and 11 at the other. Mice and ground squirrels, which are densest, are also lightest, and therefore of minimal value to humans. Dropping down to 26 to 11 animals per square mile (high density), next comes bison, wapiti, antelope, rabbits and hares, skunk, and mink. In the middle density class (ten to one per square mile), in descending order, are raccoon, porcupine, mule deer, moose, marten, and probably beaver, muskrat, otter and badger. Wolves were probably more numerous than they are now. They, too, could probably be included in the middle class although modern figures would place them lower. Low density animals (less than one per square mile) are red fox, swift fox, probably coyote, black bear, probably grizzly bear, lynx, weasel, cougar, and fisher. Excluding mice and ground squirrels, the top three choices on the basis of density are bison, wapiti, and antelope. And so it is no wonder the Indians preferred to hunt bison. Prospects for successful bison hunting had the best odds for two reasons: bison were the most numerous game animals and they also returned the greatest amount of produce per kill.

Having examined historic game preferences and basic economics underlying these preferences, I turn back briefly to the collection of animals at the Harder site. The dominance of bison, followed distantly by wolf and even more distantly by traces of five other species might result from a random hunting pattern. On the other hand, the exact correspondence between the Harder collection and the known game preference of Historic Indians in this area is remarkable. The solution to the question of chance or preference must rely upon additional faunal collections from other Oxbow sites.

OTHER OXBOW FAUNAL COLLECTIONS

At this point interest is limited to faunal remains which (a) have been collected under controlled conditions; (b) have been analysed and published; (c) belong to a single unmixed component; and (d) have been identified as Oxbow by the original investigator. Excluded are surface collections, mixed collections containing Oxbow, and collections from nearby geographic regions containing Oxbow-like materials. Five Oxbow components fit these requirements: Oxbow Dam site (Nero and McCorquodale 1958); Long Creek site, levels VII and VIII (McCorquodale 1960); Moon Lake site (Dyck 1970); and the Harder site. Two other components, Long Creek levels VI and IX appear to be Oxbow (on the basis of chipped stone tool similarities and radiocarbon dates) and are included in this comparison. Altogether this makes seven components, five from the Souris River Valley which flows through the open plains of southeastern Saskatchewan, and two from the parklands between the North and South Saskatchewan Rivers. The faunal remains from these conponents together with those from the Harder site are listed in Table VI.

In all seven components bison dominate the collection. Other large

TABLE VI

FAUNAL REMAINS FROM SEVEN OXBOW COMPONENTS

	Oxbow Dam	Long Creek				Moon Lake	Harder
		VI	VII	VIII	IX		
Area Excavated (in sq. ft.)	34	425	280	635	75	192	1393
bison	6	3	5	9	1	xd 2	17
moose							1
elk (wapiti)	1						
wolf	1						4
dog				2			x
coyote	1			1			1
red fox	1						
kit fox (swift)	1						1
hare							1
ground squirrel				1			
marten							1
goose	1					x	
frog	1						
clams	x						
SOURCE	Nero and McCorquodale 1958	McCorquodale 1960				Dyck 1970	present study

1. x indicates that the presence but not the minimum number of animals is known.
2. xd indicates that the species is present and dominates the collection but the minimum number of animals is not known.

game such as wapiti, moose, deer, antelope, and bear are rare. The only other grouping that shows any prominence whatsoever is the wolf-dog-coyote-fox series. Therefore, evidence from seven Oxbow components seem to indicate that Oxbow game preference was bison first, wolf-dog-coyote-fox a distant second, and other game more distant third. The analogy between Oxbow game preferences and historic Indian preferences in the northern plains and parklands is strongly supported.

CHIPPED STONE

INTRODUCTION

Considerable attention must be paid to chipped stone because it is the only material common to all Oxbow sites, and, in fact, to all Middle Period sites. At the Harder site, I collected 4062 pieces of chipped stone including a handful of items from the road and ditches. Out of this total, 188 pieces were chipped stone tools or parts of tools; and the balance was chipped stone debris. Tools were distinguished from debris by the presence of systematic retouching, all tools exhibiting a series of overlapping retouch scars on at least one edge. Unretouched tools, modified only by traces of wear, were searched for but not found. Several items classified as residual retouched tools, however, might be considered flakes with traces of wear by other investigators. Debris comprises the balance of chipped stone remains and includes various kinds of flakes, cores, and core shatter (see Appendix III and Plates 24 and 25).

For tools, the emphasis is on function and the evidence brought into the analysis is diverse. The classification utilized the principle of primary needs (penetrating, breaking, cutting, crushing, splitting, scraping and so on) set out by Renaud (1941) and others (e.g. Semenov 1964). Each class comprises a unique set of formal criteria which are implied by the name and detailed in a descriptive section on form, Each class possesses a range of variation indicated by measurements of basic dimensions and subsequent discussions of other aspects of the class. In order to deal with technology, subsections on material, breakage patterns (frequently related to manufacture), and analysis of chipping technique are added to each class. Finally, additional observations and analyses are presented for each class under functional and distributional subsections.

This classification method has been informally tested, confirmed, and expanded on other Oxbow collections from the Connell Creek (Meyer and Dyck 1968), Carruthers (Dyck 1972), and Long Creek sites (Wettlaufer and Mayer-Oakes 1960). The classification produces voluminous, yet ordered and integrated results. No doubt it could be streamlined if functional justifications were a matter of reference rather than one of demonstration. The components of the method are known from other studies, but the combination and application here in a justified classification is an innovation.

One of the obvious differences between a justified functional classification and a descriptive one is the reduced number of classes. By requiring an understanding of technology and artifact life stages, a functional class accommodates variant forms that might be made into separate classes in a descriptive classification. Harder site projectile points, for example, are all in one functional class with no significant technological or stylistic variants; but with two life stage variants, namely beginning and end stages, well represented while intermediate phases are almost absent. A purely descriptive classification (Dyck 1970) divided the same projectile points into two arbitrary classes on the basis of the amount of basal concavity. The two descriptive classes are about 80% coincident with the beginning and end life stage variants.

CHIPPED STONE TOOL CLASSIFICATION

Class 1. Side-notched Basally-thinned Projectile Points. (N=73)

Complete Specimens: N=25 (see Plate 17)

Form:

Without the basal concavity and side-notches, overall shape of the Oxbow type of projectile point is somewhat like an elongated teardrop.

Both lateral edges form slightly convex lines which are joined together at the tip, often by a nipple-like point, and held apart at the base by a concave edge. The two halves of the point, divided along the longitudinal axis from the tip through the mid part of the base, are essentially symmetrical. Notches are low on the lateral edges so that the proximal point of each notch is either near or else coincident with the point of juncture between the lateral edge and the basal edge. The notch is always a side notch (exclusively on the lateral edge), and is generally shallow (depth approximately one-half or less of length). About 50% show the widest part of the blade at the proximal point of the notch. Thus, it appears that notches were always positioned to straddle the widest points of the blade. The basal edge forms a sinuous line. Beginning at the point of juncture with the lateral edge, the basal edge is slightly convex for a short distance, then most of the middle distance is moderately concave and the last short section, like the first, is slightly convex before meeting the other lateral edge. The longitudinal cross-section of the projectile point is usually biplano or irregularly biconvex.

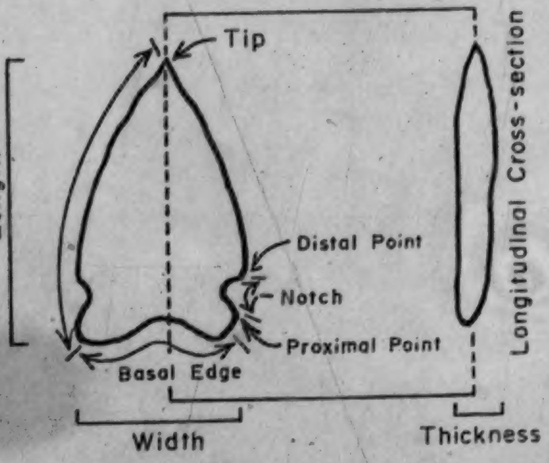


Fig. 9 - Elements and measurements of Projectile Points

The only notable variation on this pattern concerns the amount of inward curvature of the base. The most common basal incurvature possesses a depth about one-quarter of its length. The depth of this curvature, however, may be less, in rare cases almost to the point of none at all (i.e., a straight line). I have noticed that the tendency toward a straight base often occurs in the very large specimens and in small thick-based specimens. In these instances, straightness may simply reflect a minor technological necessity where further thinning would have seriously weakened or broken the specimen.

Basic Dimensions. By basic dimensions is meant the maxima of length, width, and thickness measured as shown on Fig. 9. These measurements together with the weight, material, colour, and provenience of each specimen are recorded in Table VII. The mean length, width, thickness and weight are also shown in Table VII.

Raw Material. Various colours of chert, petrified wood, silicified limestone, chalcedony, fused shale, and fine-grained quartzite were used for projectile points in this site. In general, the colours of raw material seem similar to those used for other small tools. One exception is that there seems to be a larger proportion of yellow-tan and olive-tan chert projectile points (seven) than expected. Only a few flakes and one core of this kind of chert were found in excavations, while two small (unfinished) bifaces and one end scraper make up the balance of material of this type. In general, conformity of various debitage materials to projectile point materials suggests that many tools, if not made at this site, were very likely drawn from the same general source as was the debitage. One other point that should be mentioned is a slight tendency for projectile points to be made of the best chipping material in the assemblage. Fine-grained,

TABLE VII

Basic Dimensions and Other Attributes of Projectile Points

Specimen	L (cm)	W (cm)	T (cm)	Wt (gr)	Stone	Colour	Prov.	Plate
1	a3.7 b4.2	2.5	0.6	5.8	chert	mottled tan & wh	0w15s	17a
2	a2.9 b3.1	2.2	0.5	3.1	chalced	tan	Road	17b
3	3.4	2.0	1.1	3.7	silic limest	mottled gr-wh	0w10s	17c
4	2.8	2.1	0.4	1.9	chert	olive-tan	0w0n	17d
5	2.9	a1.7 b1.8	0.5	2.2	pet wood	brown	0w50s	17e
6	a2.2 b2.8	2.1	0.5	2.0	chalced	olive-brown	42e5n	17f
7	3.0	1.8	0.4	1.7	silic shale	grey-black	0w30s	17g
8	1.9	2.1	0.3	0.8	chalced	milky-white	Road	17h
9	a2.3 b3.3	2.0	0.9	2.0	chert	tan	55e10n	17i
10	a1.9 b2.7	1.9	0.5	1.7	chert	black	E Trnch	17j
11	2.8	1.5	0.3	1.3	chalced	brown	0w5s	17k
12	a2.8 b3.4	2.0	0.6	2.3	chert	olive-tan	15e10s	17l
13	2.5	1.9	0.9	1.6	silic limest	grey	0w35s	17m
14	3.2	2.3	1.0	2.4	pet wood	dark brown	0w55s	17n
15	a2.6 b3.2	2.5	0.9	2.2	chert	white	15e15s	17o

TABLE VII (cont.)

Specimen	L (cm)	W (cm)	T (cm)	Wt (gr)	Stone	Colour	Prov.	Plate
16	a2.2 b3.2	2.1	0.5	1.7	chert	yellow-tan	Ow15s	17p
17	3.0	a1.4 b1.8	0.4	1.6	chert	grey	Ow15n	17q
18	2.6	2.1	0.6	1.6	silic limest	white	Ow50s	17r
19	a3.6 b4.2	2.0	0.5	3.3	pet wood	brown	Ow55s	17s
20	2.4	a2.0 b2.2	0.5	1.7	pet wood	brown	15e5n	17t
21	2.2	1.4	0.3	1.2	silic limest	white	W Tr	17u
22	2.3	a1.8 b2.0	0.4	1.5	chert	white	Ow5n	17v
23	a2.0 b2.1	a1.9 b2.2	0.3	1.4	chert	pink-orange	Ow0n	17w
24	1.8	a1.2 b1.6	0.3	0.7	silic limest	mottled white	Ow25s	17x
25	a5.2 b10.0	5.6	1.3	a35.8 b60.0	silic limest	mottled wh-gr-bl	Ow35s	17y
$\overline{X}$	2.9	2.0	0.5	2.1				

Notes: a denotes a broken specimen

b denotes an extrapolated measurement for a broken specimen

c abbreviations used are:

L = length
W = width
T = thickness
Wt = weight
Prov = provenience
chalced = chalcedony
silic limest = silicified limestone

pet wood = petrified wood
silic shale = silicified shale
wh = white
gr = grey
bl = blue
trnch = trench

homogeneous, and relatively unfaulted stone would be preferrable for edges and surfaces requiring extensive, yet delicate retouching. Since projectile points are slightly ahead of other bifaces and some end scrapers in terms of the amount of edge and surface area requiring retouch, the tendency toward better material in projectile points is understandable.

Broken Specimens. In addition to 24 more or less complete side-notched projectile points and one extra large specimen, small parts of 48 more side-notched points (see Plate 18) appeared in excavations and on the road. The most common lines of breakage are (1) diagonally from one lateral edge to the other near the tip, and (2) diagonally from the mid-point of a notch to the mid-point of the basal concavity. Less common breaks occur (3) from the mid-point of one notch to the mid-point of the other, (4) from the mid-point of basal concavity to a lateral edge near the tip, (5) from one lateral edge to the other just above the notches (usually straight across), and (6) shatter (several lines of breakage occur). The small parts found include 17 tips, 12 'ears' three bases, one longitudinal section, four midsections and tips, and 11 pieces of shatter.

The stone material is similar to that of the more complete specimens. It includes 24 cherts (four tan-olive, six yellow-tan, three white-orange, four mottled white, three black, two grey, and one brown), eight petrified wood (six brown and two black), two fused shale (grey), two Knife River Flint, and two quartzite (white and yellow-tan). The size of these parts is consistent with their counterparts on complete specimens. One interesting fact that emerged after considerable time had been spent trying to fit the pieces together (both by lines of breakage and by similarity of materials) was that none of the parts matched with each other or with any of the more complete points. Each part represents a separate projectile point.

Chipping Technique. My analysis of chipping technique for the shaping of projectile points is based on observation of surface scars. Such observations can be most easily made on specimens of fine-grained, lustrous material such as obsidian or certain kinds of cherts. Coarse-grained and/or faulted materials such as quartzite, quarts, silicified limestone and petrified wood tend to be difficult subjects upon which to observe flake scars as the edges of scars seem to be diffused or feathered rather than sharp and clear. By tipping the points back and forth and by keeping the source of light low and to one side relative to the surface under inspection, I was able to see most of the flake scars clearly. Looking at only more or less complete side-notched projectile points, one is limited to observations of the last phases of chipping, specifically, finishing the lateral edges, thinning and shaping the base, addition of notches, abrasion of certain edges, to some extent the sequence of these operations and, finally, repairs to broken points.

Lateral edges. Two types of flake scars can be seen along the lateral edges of the projectile point. Both originate at the edge and are directed toward the thick central area of the point. The first type is the largest. It is usually broad, shallow and long, leaving a long narrow indentation along the edge representing the striking platform of the removed flake. The channel of the flake scar is shallow, but broad, and usually penetrates up to or into the thick central area. These scars occasionally overlap one another along the edge. When they do not overlap, a slight ridge is left between Type 1 flake scars. The purpose of the chipping process represented by this first type of flake scar seems to be overall thinning of the blade of the projectile point, and at the same time shaping of the lateral edge. Usual shape and position of such flake scars is shown in Fig. 10a. Type II flake scars are narrow and shallow and may penetrate into the central area of the point, or terminate in a hinge fracture a few millimeters from the edge. The chipping process represented by these scars served to remove ridges left by broad thinning flakes and to smooth the undulating edge into an even curve. This second type of lateral edge flake may be termed narrow finishing flakes. Shapes and locations of narrow finishing flakes are shown in Fig. 10b.

Base. The same two types of flakes were used in working the base but the application was slightly different. At the preform stage, the base probably started off straight except for a little upward rounding where corners met lateral edges. Then, either single flakes centered on the longitudinal axis, or paired flakes balanced on either side of the longitudinal axis (or a mixture of both) were removed by alternating bifacial retouch until either the desired thinness or basal incurvature

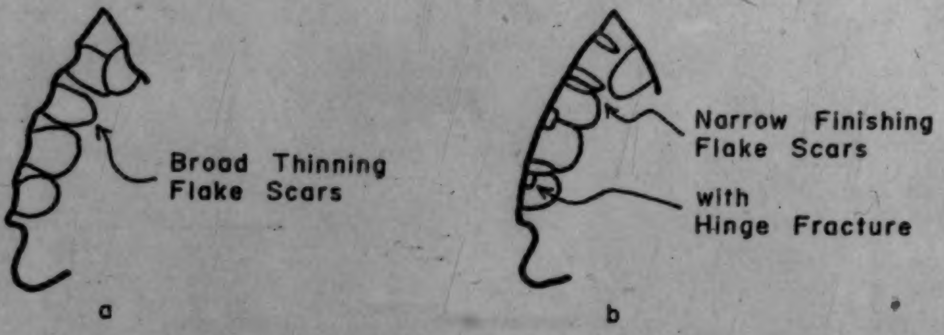
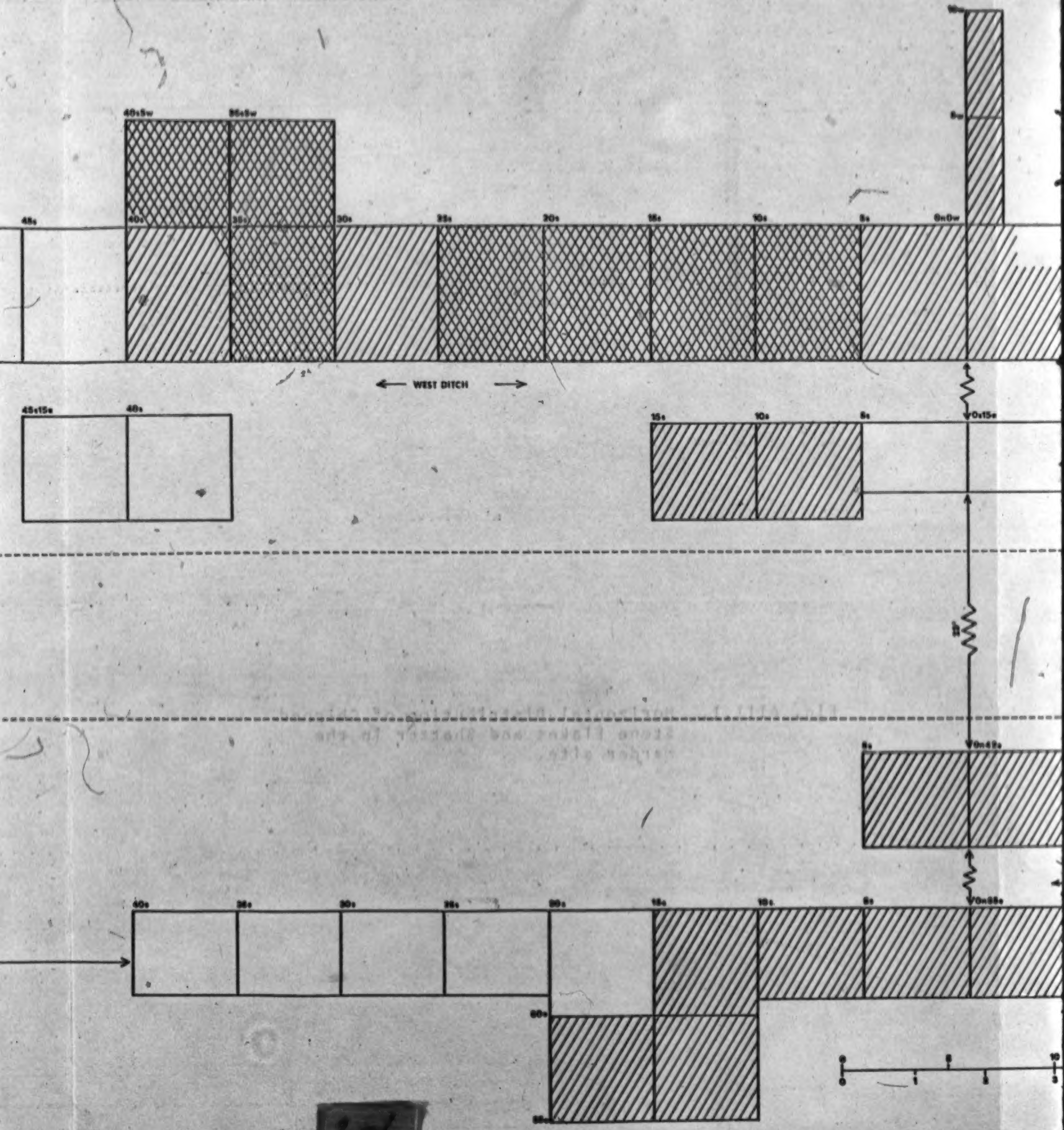


Fig. 10 - Projectile Point Lateral Edge Flakes

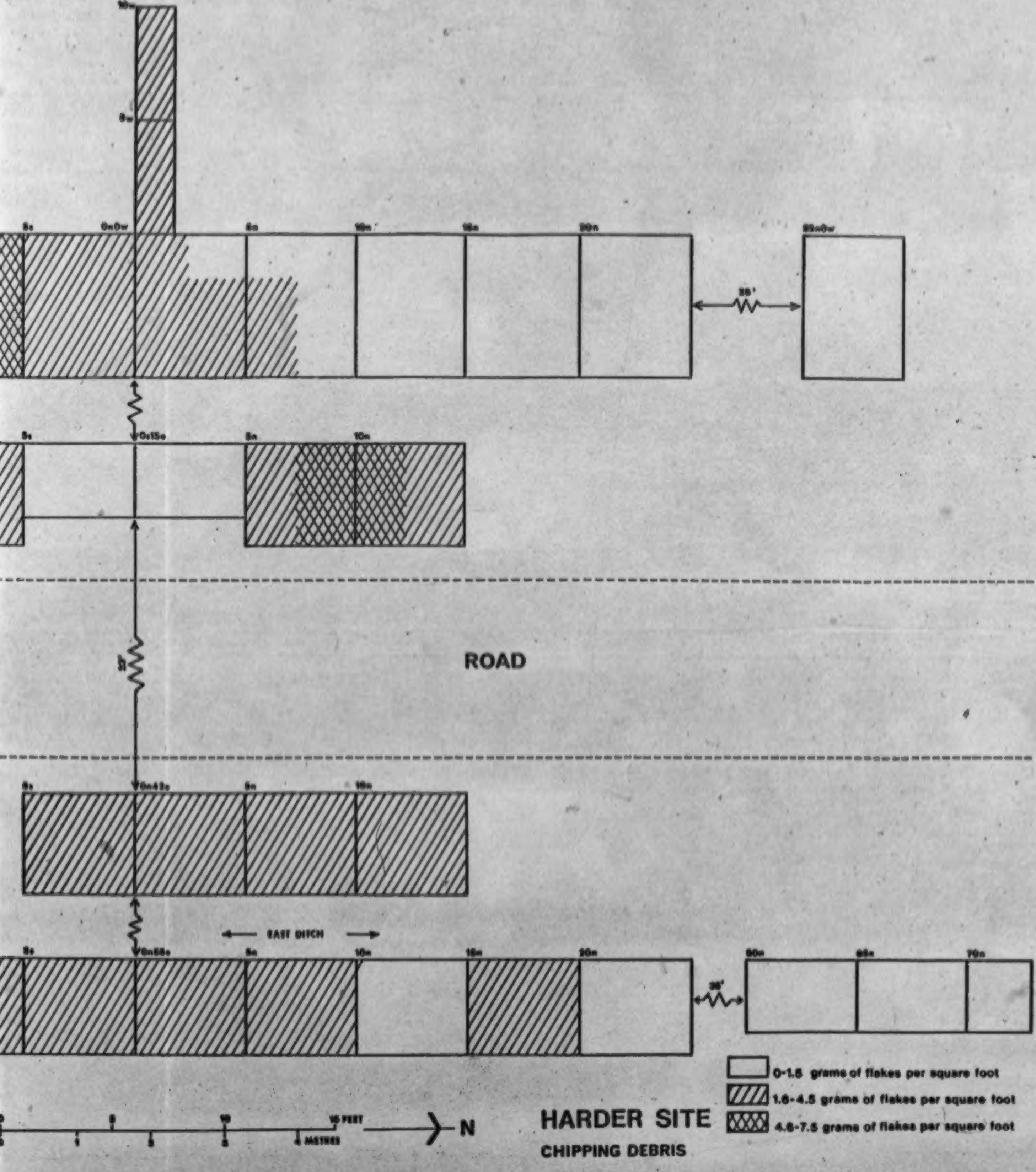
was achieved. Thus scars of the first basal thinning flakes were obscured by the next ones on the same face, and in most cases only the last flake or pair of flakes can be seen. Often these flake scars are broader and longer than their counterparts on the lateral edges; but the shape is the same and, proportionally, size of basal edge area is the same, in the few instances where the indentation associated with a single flake has been left unaltered. The amount of basal edge removed by just two flakes (from alternate surfaces) would not account for the marked basal incurvature seen on most specimens. This fact is the basis for the statement that removal of flakes was bifacial and alternating. At the end of the thinning process, and possibly during it, ridges of the large thinning flakes were removed by small narrow thinning flakes, a practice which also smoothed the basal edge. These little flake scars often terminate in hinge fractures. Often, too, the last thinning flake scars on the basal edge were a centred pair on one surface and a single broad centred flake on the reverse surface. Shapes and positions of basal flakes are shown in Figs. 11a and 11b.

One other feature noted occasionally on basal edges, particularly unabraded ones, was a remnant of the striking platform of the original projectile point flake blank. The platform is a small flat oval surface perpendicular to the plane of the edge and located on the basal edge touching the point of juncture with the lateral edge. Shape and position of the platform are shown in Fig. 11c.

Notches. Both chipping and edge crushing seem to have been components of the notching technique. Initially, the notch was started by removing the usual broad lateral edge thinning flakes, one on each surface. In this way a shallow indentation was formed on the edge and, coin-


40s5w
35s5w
10w
5w
45s
40s
35s
30s
25s
20s
15s
10s
5s
0n0w
WEST DITCH
45s15e
40s
15s
10s
5s
0s15e
23'
5s
0n42e
0n55e
40s
35s
30s
25s
20s
15s
10s
5s
60s
65s
0
5
10
0
1
2
3

2 of


10w
5w
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0n0w
5n
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25n0w
25'
5s
0s15e
5n
10n
ROAD
5s
0n42e
5n
10n
EAST DITCH
5s
0n68e
5n
10n
15n
20n
25'
60n
65n
70n
0 5 10 15 FEET
0 1 2 3 4 METRES
N
☐ 0-1.5 grams of flakes per square foot
▨ 1.6-4.5 grams of flakes per square foot
▩ 4.6-7.5 grams of flakes per square foot

HARDER SITE
CHIPPING DEBRIS

example a core and a rejected projectile point preform) or they may have been distantly related or unrelated in time and place (for example a core and a worn out projectile point from some other source).

Comparison of the distribution of cores and densities of debris shows that cores were generally not in the areas of greatest density, but were usually in areas of intermediate debris density. This distribution is unexpected as it would seem reasonable to presume a strong correlation should exist between cores and other chipped stone debris especially since debris is compared in terms of weight not number. In comparing debris densities with distribution of chipped tools one notices approximately the same relationship as between cores and tools. Some dense concentrations of debris coincided with concentrations of tools; others were beside tool concentrations. Occasionally there were moderate concentrations of tools in places where density of debris was very low, as, for example, in units 0w45-65s or units 0w15n. But in general, it seems that chipping activities occupied much of the same space as activities resulting in the deposit of other types of materials.

APPENDIX IV

ETHNOGRAPHIC AND ARCHAEOLOGICAL DATA RELEVANT TO SMUDGE PITS

RELEVANT ETHNOGRAPHIC OBSERVATIONS

Binform (1967) has laid the groundwork for a smudge pit analogy at another site by searching out 13 ethnographic descriptions of the use of smudge pits by Southeastern, Plains, and Great Lakes Indians. Over a large part of North America, it seems these pits were in universal use, showing a limited range of variation in size, shape, and contents. Four observations on Plains tribes are reproduced below.

> The Dacotah (Sioux), 1800 - 1850
> If after all this working, the skin is hairy or stiff, it is drawn over a cord as large as a finger, for some time, as hard as they can pull, which softens it much: sometimes this is the last process, except smoking. This is done by digging a hole in the ground about a foot deep, putting in a little fire and some rotten wood, then the skin is sewed into a bag and hung over the smoke: in 10 minutes the skin is ready for use. (Schoolcraft; 1956:61)

> The Blackfoot, 1850 - 1900
> The color and finish were imparted by smoking. The skins were spread over a frame similar to that of a sweat house, a hole was dug underneath and a smouldering fire maintained with sage or rotten wood. (Wissler 1910:65)

> The Crow, 1800 - 1850
> The greater part of these skins, however, go through still another operation afterwards, which gives them a greater value and renders them much more servicable - that is, the process of smoking. For this, a small hole is dug in the ground and a fire is built in it with rotten wood, which will produce a great quantity of smoke without much blaze; and several small poles of the proper length stuck in the ground around it and drawn and fastened together at the top, around which the skin is wrapped in form of a tent, and generally sewed together at the edges to secure the smoke within it, within this the skins to be smoked are placed, and in this condition the tent will stand a day or so, enclosing the heated smoke. (Catlin 1880:52)

> The Arapaho, 1900 - 1939
> ...After it was as soft as she wanted it she dug a hole, about

> 20 inches deep and about 15 inches in diameter, and built a smudge in it, using either fine chips of wood or bark of a cottonwood. She then sewed up the hide to make a sack of it with one end open. She placed this sack over a tipi-shaped framwork made of saplings and set this over the smudge. She watched the smudge carefully so there would be no blaze, but only smoke. At the closed end of the sack she had sewed a strip of buckskin with which she tied the sack to the top of the saplings. This held the hide in place. When one side of the hide was sufficiently smoked, the sack was turned inside out and again smoked, thus giving both sides a tan. (Hilger 1952:184)

These quotations give the purpose of the smudge, the manner in which the hide was suspended over it, and the nature of pit and fuel. There is a general correspondence between the shape and size of Harder pits and historic pits with the exception that historic pits seem deeper. The Harder site pits are in fact within the known range, but at minimun recorded depth. Other areas of correspondence between Harder and historic pits are soft, porous organic remains (bark, twigs, rotten wood, dung, and sage historically); carbonized organic soil (contents burned in a reducing atmosphere historically); and little or no disturbance (historically, the removal of the hides did not result in the disturbance of the contents of the smudge pit). The lack of evidence of a structure over the Harder pits for suspending a hide may be due to absence or lack of preservation in soft sand.

I would like to pursue two aspects of the Harder pits a little further, namely, shallowness, and fuel. The black soils from the pits were not examined for physical indication of what fuels were used, but the distribution of white-charred bone throughout the pits suggests that the pieces fell upon a firm, compact fuel. If a layer of fuel and a sprinkling of hot bone segments were added repeatedly the Harder situation might happen. Shredded bark or finely broken twigs or crushed rotten wood might well have provided such a uniform layer into which the red hot bone would burn with much smoke.

Bison dung is another possibility. Historical observations give further information of interest on burning bison dung.

Regarding the smudging qualities and use of a hot burning material to start buffalo dung on fire.

> Fort Qu'Appelle, 1867
> True, dry buffalo dung lay almost everywhere beneath the snow, but it only made, even when heaped up like a haycock, a smouldering "smudge," on which the kettle boiled and the frying pan served its purpose; but without shelter from the cold...a very poor apology for a wood camp fire. Anything in the shape of a tent or lodge was considered too great an impediment on a trip performed with already heavy laden dog trains, carrying, besides the regular load, a few sticks of dry wood to make the shavings necessary to start the buffalo dung to burn. (Cowie 1913:208) (emphasis mine)

The fact that dung was actually used for hide smoking is mentioned by Swanton (1911:64) who reports that in 1753 Dumont said about the Natchez:

> They fill this hole with cow dung, rotten wood and maize ears and place over it two rods in the shape of a cross, the four ends of which are slanted in the earth so as to form a kind of cradle on which they stretch the skin they wish to tan.

The depth of the pits cited in ethnographic observations (Binford 1967) varies from 15 cm to 50 cm. The Harder site pits were just at or a little below the minimum recorded ethnographically. One wonders what factors control this remarkable consistency in smudge pit depth. Probably hardness of the soil was one factor: a deep, small-mouthed hole would collapse in loose sand, but could be built into clay. The Harder site soils would not sustain a deep small-mouthed hole. Beyond physical restrictions in excavation, what purposes might be served by a deeper or shallower hole? Considering the smudge three things could be done to foster an oxygen-starved environment: (1) dig the hole deeper, (2) peg the bottom of the hide down to the ground to prevent drafts, and (3) shelter the whole smudge and hide complex. Outside on the open plains, a combination of deep hole and pegged bottom would do the trick. On a windy day or in the shelter of woods or a tent, the third option could be used negating the need for a deep hole and thorough pegging. A suspension apparatus would of course still be required for the hide. It is interesting to note that in the ethnographic observation with the shallowest pit, a clear specification for the whole hide smoking complex is shelter.

> Menomini, 1900 - 1920
> A hole about a foot wide and six inches deep is dug in the earth in a locality sheltered from the wind, and a slow glowing, smoky fire is made in the bottom of the pit with dead branches, punk, or even dry corn cobs. Over this the inverted bag is suspended and pegged down about the base. (Skinner 1921:228)

The shallow pits at the Harder site may indicate that the site was in a sheltered area or that the smudge pits were inside dwellings.

Archaeological Analogue

An analogous feature was discovered at the Long Creek site (Wettlaufer and Mayer-Oakes 1960) toward the bottom of Level 8 which is an Oxbow component. The feature consisted of a small pile of charcoal surrounded by two concentric circles of post-holes. The inner one was about 90 cm in diameter and consisted of 18 small holes. The outer circle was about 147 cm. in diameter and consisted of seven evenly-spaced larger holes. The larger holes were approximately 15 cm deep and the smaller ones 8 to 10 cm deep. The holes were in a greyish clay matrix and were filled with ash and camp debris. No artifacts were found in association with the feature. (Wettlaufer and Mayer-Oakes 1960:64-67). Wettlaufer interpreted the feature as either a ceremonial structure or a skin smoking apparatus:

> The whole feature may have been used as part of a ceremony. ...One can well imagine sweetgrass or other aromatic substances being burned on the coals so that the smoke curled up around the central object. The rough circle of smaller holes may have

> contained smaller poles lashed to the main four pole structure with still smaller poles fitted around the outside. The whole structure may have looked something like a miniature circular lodge. It is possible that it was a miniature house type designed as a small shrine.
>
> ....A practical function for this feature is suggested by Lowie in his work on the Assiniboine where he states, under the section on the tanning of hides, "For smoking the skin is sewed up and the lower end is pegged down around a smouldering fire until tanned to the desired shade." (Lowie, 1909, p. 12) This solution would seem most logical, if it were not for the fact that although lower level 8 was quite extensively excavated, no other such feature was found. Surely this type of function would have been more commonplace in a group of people having a hunting and food gathering culture. (Wettlaufer and Mayer-Oakes 1960:64-7)

Wettlaufer's interpretation clarified one point not clear in his description or photograph: there were four large post-holes and three other post-holes outside the circle of 18 small ones. The four large post-holes could be the remains of either a tipi-shaped framwork or a dome-shaped framework. According to ethnographic observations, both were used and both required four poles. The small holes of the inner circle would fit well with the idea of a hide pegged down around the bottom. Wettlaufer's ceremonial interpretation shows that archaeologists need not depend solely on ethnographic analogy for models. While the ceremonial postualte may be valid, it seems weaker than the hide smoking hypothesis which shows several lines of evidence corresponding with the ethnographic situation. Even Wettlaufer's objection that there were too few of the features to have been smudge pits, turns out to be a predictable pattern connected with hide smoking. In fact not all hides were smoked. Wissler (1927:61) distinguished three kinds of prepared hides: (1) rawhide, (2) soft-tan finish and (3) buckskin. The first two kinds were very commonly made and involved no smoking. For example, Wissler's detailed description of the soft-tan process is concluded with no mention of smoking.

> ....After this, come the rubbing and drying processes. The surface is vigorously rubbed with a rough-edged stone until it presents a clean-grained appearance. The skin is further dried and whitened by sawing back and forth through a loop of twisted sinew or thong tied to the under side of an inclined tipi pole. This friction develops considerable heat, thereby drying and softening the texture. As this and the preceding rubbing are parts of the same process their chronological relation is not absolute, but the usual order was as given above. The skin is then ready for use. (Wissler 1927:61)

What Wissler calls 'buckskin' was the only hide that was smoked:

> Buckskin was prepared in the same manner as among the forest tribes. The tribes of the western plains were especially skillful in coloring the finished skin by smoking. (Wissler 1927:62)

The actual ratio of rawhide, soft-tanned skins, and buckskins is not supplied by Wissler. It does seem that smoking was regarded by Wissler as a decorative technique applied only to some of the finished hides. If this is so then we would not expect to find a great many smudge pits in a site occupied by nomadic hunters and gatherers. Some women might have tanned hides only into rawhide and soft-tanned skins. Other women in the same camp may have had a sufficient supply of rawhide and soft-tan hides, and it would have been they who made their hides into buckskin, leaving traces of smudge pits. Wettlaufer notes that in the whole area excavated for Level 8 at Long Creek, he found only one smudge pit. In the Harder site, in an excavated area a little more than twice the size of Long Creek, two were discovered.

APPENDIX V

ETHNOGRAPHIC AND ARCHAEOLOGICAL DATA RELEVANT TO BOILED BONE SPILL PILES

RELEVANT ETHNOGRAPHIC OBSERVATIONS

The importance of animal bones as a food source is readily apparent in the writings of early observers and later ethnographers. From this literature comes a general idea of the parts of the bone that North American Indians valued (marrow and bone grease) and the general method (breaking and boiling) by which they obtained them. The fine details of interest to an archaeologist are usually lacking in historic observations, but recent studies such as by Zierhut (1967) give even these. The following quotations summarize the information gained from historic and ethnographic accounts.

> Hidatsa Indians, 1850-1900, The Value of Bones for Food
> When they returned, each hunter packed a load of meat on his back. Only the choice cuts were brought back in this fashion; the tongues, the kidneys, and the ham bones for the marrow; the rest of the meat was left behind on the meat pile. Some of the ribs with the meat clinging to them were also brought in. (Wilson 1924:249-50)
>
> ...My father found a pile of bones left by a party who had killed buffalo; and brought back as many of them as he could carry, as they were fresh and had not spoiled in the cold weather. He brought them for the bone grease (marrow). ....He went outside the tent and pounded the bones with our hatchet (small ax) and cut them up. "I have found a great deal of grease," he said. He meant, of course, that the bones were rich in grease. (Wilson 1924: 301-2)
>
> Mandan Indians, June 1811, Processing bone during a hunt
> ...On the great hunting parties, the women are employed in preserving the hides, drying the meat, and making provisions to serve them during winter. Very little of the buffaloe [sic] is lost, for after taking the marrow, they pound the bones, boil them, and extract the oil. (Brackenridge 1904:137)

Plains Cree, 1860-70 Breaking Bones, Names for Different Grease

Large bones were split open and pounded with a maul. The crushed splinters were placed in boiling water; the grease that rose to the surface was skimmed off with shell spoons and stored in buffalo paunches. It was called oskanpimi (bone grease). Fat from shoulder and rump was placed before a fire and as it melted dripped into a hide container. This was called sasipmanpimi (frying grease). (Mandelbaum 1940:193)

Kutchin or Loucheaux Indians, 1946, Breaking and Boiling Bones

Bone Grease (in Old Crow) is made from caribou and moose bones. After the meat has been cut off, the bones are left for one day, which allows them to dry a little. If the bones were left for two or three days, the bone grease made from them would taste too strong to be pleasant. A caribou skin from which the hair has been removed is laid on the ground and an anvil stone is placed in the middle of it. The bones to be broken are placed on the anvil stone and are smashed into little pieces, "as big as finger nails," with the back of an axe. In the old days stone hammers were used for this. The broken bones are then put in a kettle with a little cold water and placed on the fire. As soon as the water comes to a boil, cold water is added (snow in the winter time) so as to keep the water simmering rather than boiling violenty. The grease is skimmed off and put in a separate vessel, usually the small inner part of a caribou's stomach. Here it will keep quite well for as much as two or three years. Some of it was used for making the best grades of pemmican, for pemmican was made in this part of the Yukon, and some of it was kept for daily use in cooking.
(J. McDonald, in Leechman 1951:355)

Calling Lake Cree, 1967, Bone Breaking and Boiling

Once the marrow is obtained from both the distal and proximal sections of the bone, what remains of the shaft is broken into smaller pieces to be used in the preparation of bone grease. This is done by placing the broken end upon one of the stones and hitting the shaft one or two times with the blunt end of an axe. The only recognizable portions of the bone that remain are the distal and proximal ends. The small fragments along with the ends are then collected for the purpose of preparing bone grease.

As for the mandible, the inferior portion of the body and most of the ramus is broken out by blows from the blunt end of a small axe. An anvil stone may be used in this operation. Marrow is obtained from the cavity in the body of the mandible immediately inferior to the alveolar portion. Often the mandible is further broken into small sections in order to be used in making bone grease.

...The process of making grease is as follows; all bone fragments are gathered and placed in a large pot containing water. The bones are boiled very slowly, and the fat which floats to the top is collected and eventually eaten. (Zierhut 1967:35)

Archaeological Analogues

The ethnographic observations end without describing the disposal of the boiled-out bones. Fortunately the remains of whole bone boiling complexes have been discovered and recognized at archaeological sites, where bone disposal can be partly observed. At site 48 JO 312, Wyoming (Frison 1967:12-13), 14 small stone circles consisting of granite boulders were found in the butchering area. One circle had a central depression filled with broken bison bone and fire-fractured stones interpreted as a receptacle for stone-boiling fat and marrow from bones. Large boulders were near six of the other circles. One of the boulders was surrounded to a depth of five inches with broken, but apparently unprocessed bone. Presumably bone was being broken near the circles in preparation for boiling. Also at 48 JO 312 were seven pits, .6ft to .8ft deep and 1.8ft to 6.5ft in diameter, presumably lined with hides and used as stone-boiling vessels at one time. The pits contained broken bone, and granite boulders, some of which were fire-fractured. Occasional small piles of broken bone suggest that pit liners were removed from time to time and the contents dumped to the side. Frison concludes that the stone circles and pits were functionally similar.

Features at 48 JO 312 left rather clear types of remains; one type , rings of stones above ground, the other, pits full of bone and stone below ground. Both kinds of features were essentially intact. Once bone-boiling was finished, the complex was simply abandoned Granite boulders left in situ probably indicate that they were abundant in the area so that occupants did not have to dismantle the circles and pits when they left. One would not expect to find so many unbroken heating stones in a sandy region where people would have taken the best stones for the next camp. The Frison description refers to small piles of broken bone to one side (of the boiling features) representing periodic disposal of boiled-out bone fragments. For our purposes it would have been extremely interesting to know the shape and location of these piles and the condition of the bone.

Bone Boiling Pits, Cormie Ranch Site, Alberta. (Losey 1971:26-28)

> ....The excavation revealed remnants of at least four bone boiling pits which had been placed in the sandy subsoil to a depth of about 1½ to two feet. The vast majority of the fragmented bone would pass through a one-half inch screen although a small percentage (ranging from 3-½% to 22% by weight per pit) could be identified. Most of the identifiable bone represents the lower limb elements since these are the hard, dense portions of the skeleton. Fragments of vertebral processes, articular portions of ribs, teeth fragments and ear ossicles are exceptions but suggest that the entire animal was being utilized. That material which is of diagnostic value has been identified as Bison Bison Spp..
>
> While the limits of the boiling pits (Features 1 through 4) were not always clear, the arrangement of the bone fragments often outlined the boundary of each feature (Fig. 9). However, Feature 1 which is the only pit completely excavated did reveal a clear profile due to differential moisture content when freshly exposed (Fig. 10). Feature 1 had a content of unusually large bone fragments in the very bottom of the pit (Fig. 11) along with a large battered quartzite cobble which may have been used to pulverize the included bone. ...
>
> ...Feature 4 was well defined by the circular arrangement of bone fragments....
>
> ...Noticeably lacking, however, were the boiling stones which are normally heated and used to bring the water to a boil. A logical reason for this omission may be due to the fact that stones of sufficient size and quantity do not normally occur in a deposit of beach sand. It is likely that these stones were removed from the boiling pits and cached for future use thus eliminating the necessity of transporting new materials over some distance.
>
> The surface of occupation Level 2 surrounding the boiling pits is strewn with additional bone fragments all obviously derived from the features themselves. ...The surface may also have been used as a refuse area for material derived from pits for which there is no record. This explanation may better fit the case since there is also some debitage, broken projectile points and a few other artifacts (Fig. 12). (Losey 1971:26-8)

> Two small clusters of bone fragments recovered from Square 6S/0E are derived from the boiling pit activity. The condition of this "cooked" bone is quite distinct when compared to either charred or calcined material. It is very hard and extremely light in weight. These two clusters extend several inches below the level of the living floor and are perhaps remnants of other boiling pits. (Losey 1971:29-30)

The bone boiling pits described by Losey supply additional information about the contents and shape of bone boiling pits, the disposal of the boiled-out bones, and the nature of boiled-out bone. The identified comminuted bones appear to be mainly from limbs, with best representation by hard, dense bones (carpals, tarsals, phalanges and long bone ends) as might be expected in the light of bone breaking techniques (Zierhut 1967; Bonnichsen 1973). Although dominated by limb bones, a trace of other regions such as vertebrae and ribs, and certain skull parts and teeth were recovered, as at the Harder site. Boiling stones were absent from the pits, a circumstance Losey attributes to dismantling the feature to cache stones for future use. One large quartzite rock found in the very bottom of Feature 4 was attributed the function of bone breaking anvil or hammer because of the association of unusually large bone fragments. It seems to me that breaking bones in the bottom of the boiling pit would be awkward. Another explanation is that the rock was simply a heating stone in direct contact with bone fragments which it helped to boil.

One interesting thing about the Cormie Ranch bone boiling pits is that most of the comminuted bone is right in them. Excavations near the pits show fragments scattered around, with small pockets here and there; but no large concentration indicative of periodic cleaning of the pit. The two small clusters identified as being derived from boiling pit activity were 5.2 m away from the boiling pits area and apparently isolated from other features. In this they are similar

[redacted]

to the Harder feature. The observation that the "cooked" bone was very hard and extremely lightweight was not readily confirmed at the Harder site.

Seven phases of bone boiling activity, the equipment used historically for each of the phases, and archaeological equivalents both observed and potential, are summarized in Table AV.1 Interest in Feature No. 8 leads directly to the last two phases of activity, maintenance of boiling apparatus for reuse, and disposing of boiling apparatus and residue. Ethnographic observations supply no information on either subject. Archaeological observations, often lightly interpreted, do. A little probing into the already excavated features at Site 48 JO 312 and the Cormie Ranch site provide some relevant ideas.

The evidence for maintenance or cleaning of bone boiling pits was small piles of cooked bone to one side at Site 48 JO 312, small piles of 'cooked bone' 5.2 m away from the boiling pit area at Cormie Ranch, and broken bones thinly strewn around the boiling pit area at Cormie Ranch. This evidence should be questioned, because there is a lack of correspondence between small piles of cooked bone found outside pits and large quantities of cooked bone in each pit. Surely it would not be necessary to clean a pit that had only a small amount of cooked bone in it. Thinly strewn bone about pits is not strong evidence of maintenance.

One can hypothesize that the procedure for cleaning a pit would be to: (1) spoon off most of the water (optional), (2) lift the hide and bone out as a unit (3) carry to a suitable disposal area, (4) spill out the bone and heating stones, (5) pick out the reusable heating stones, and (6) replace the hide. If this procedure was used there would be a considerable quantity of boiled-out bone left in a concentration somewhere.

TABLE AV.1

SEQUENCE OF EVENTS AND ATTRIBUTES OF A BONE BOILING COMPLEX

Activity and ethnologically observed attributes	Archaeologically observed attributes
1. Removal of periosteal sheath- Burnt off on coals of open fire; scraped off (Bonnichsen 1973).	(Hearth); (bone or stone scrapers); (striations on broken bone).
2. Bone Breaking - one or two anvil stones; one small axe or hammerstone.	anvil stone, hammerstone, broken bone.
3. Gathering broken bone - pick up skin; or collect by hand.	negative evidence - (clean ground around anvil; or bone leftovers around anvil).
4. Bone Boiling - Kettle, water, bone fragments, fire.	Bone boiling pit or above ground apparatus, boiling stones, hearth, broken bone, broken stones.
5. Grease Collection - spoons for skimming, skins or paunches for storage.	No evidence.
6. Boiling Apparatus Maintenance- No information	Bones thinly strewn about boiling pits, small piles of cooked bones near pits and far away.
7. Disposal of boiling apparatus and residue - No information	Two possibilities: (a) abandonment as is (b) reclamation of hide and/or best heating stones.

() indicate an attribute potentially in the archaeological evidence, but not observed to date.

The final disposal of the boiling apparatus and its contents is quite clear at both site 48 JO 312 and at Cornie Ranch. At site 48 JO 312, once the grease had been taken the boiling pits were probably abandoned as they lay. The boiled bone and heating stones were left as they would have been during the boiling process, and the hide disintegrated in situ. At the Cormie Ranch site, however, the boiling rocks were removed from the pits. There is also evidence that the hides were retrieved from the pits (Losey, personal communication). As broken bones lay mainly in a slanting layer extending from one side of the rim of the pit down to the base. If the hide had been pulled out from the same side, this arrangement of bones should be expected. At neither 48 JO 312 nor Cormie Ranch was there a recognizable empty boiling pit. From this fact one might tentatively conclude that boiling pits were used only once and then abandoned.

But before generalizing, one should look at the kind of sites in which boiling pits occur and the circumstances under which they were used. Both 48 JO 312 and Cormie Ranch pits seem to be in the butchering area a short distance from the kill site. The location of the kill area was established for site 48 JO 312 and a good hypothesis for the location has been suggested for Cormie but is untested. One point to note for both sites is the multiple occurrence of boiling pits. At site 48 JO 312, boiling pits were scattered throughout the butchering area, occasionally forming a clustered feature in combination with stone circles, stone roasting pits, and other boiling pits. At the Cormie Ranch site all four pits were tightly clustered in one area. It has been noted that bone boiling is a slow process. One way to speed it up would be to make as many pits as were required to accommodate all broken bone at once. This procedure would allow hunters and helpers to finish processing the bones in the shortest possible time; furthermore, since the butchering area was not part of the everyday living area people didn't need to spend time cleaning it up. When they had no further use for a pit, they could simply leave it.

APPENDIX VI

ETHNOGRAPHIC AND ARCHAEOLOGICAL DATA RELEVANT TO BONE PILES, GENERAL DISPOSAL AREAS, AND HEARTH/REFUSE AREAS

RELEVANT ETHNOGRAPHIC OBSERVATIONS

Most early observers do not mention the distribution of bones in Indian camps, even though they may have taken time to notice what kinds of animals were represented by the bones. The two following quotations provide examples of this general kind of observation:

Sarcee Camp, 1810, south central Alberta.

> ...We soon came to Riviere de la Loge de Medecine where we found still burning the fires of the Sarcees, who left the spot this morning-25 tents. They must have made a good hunt here in beaver, bear, moose, red deer, and buffalo, as a great quantity of bones lay about their camp. (Alexander Henry 1965:638)

Sioux Camp, 1811 central south Dakota.

> ...Before reaching the upland we observed on the river bottom a large encampment of Sioux, where they had probably remained during the winter, from the traces of tents, the quantity of bones, and the appearance of the ground. (Brackenridge 1904:105)

I am aware of only one account in which the distribution of bones within a camp site is described:

Parkland Indians, 1906, south central Saskatchewan.

> This prairie district was the home of vast herds of buffalo in the days when steaks were cheap. Many traces of buffalo hunts were to be found, and the old Indian camp sites could be read like a book. There would be several rings of stone marking where each tepee stood, generally six to a camp, and a main bone pile, flattened out, with the large bones broken to get at the marrow. Other bones were scattered for about one hundred feet around the camp. (Donaghy 1954:64)

Indian Tipi, c.1886, near Calgary, Alberta.

Historic photographs provide a more detailed but almost uninterpreted source of ethnographic information, some of which is of value to our present purpose. A historic photograph (Public Archives of Canada, PA 66595 (captioned 'Migrating Indians at Calgary, Alta., c.1886') gives a closeup view of a tipi, several horses, and dog travois leaning against one another and supporting strips of meat and a pile of branches and bones at the side of the tent (see Plate 30).

The pile of branches no doubt served for firewood. The presence of the bleached white bones in the firewood pile is curious, as the bones seem too white to have been derived from the same animal as the meat drying on the travois racks. The little boy on the pile appears to have one hand on a white object which is being bitten by a dog standing beside the boy. Just below the boy's hand is another white object resembling the neck vertebra of a bison. The bones may have been saved by the woman for dog food. One wonders if the accumulation of bone near the door might have been enough after several kills and a few weeks residence to leave a concentration, resembling Feature 4, in the archaeological record. In any case this photograph records a close up view of a tent and its immediate environs shortly after a kill. The one place where bones are at all concentrated is in the pile just outside the door.

Cree Camp, 1871, Fort Carlton

The best supporting evidence for the arrangement of bones described by Donaghy is a photograph (Public Archives of Canada PA 9176) taken by Charles Horetzky in September 1871 (see Plate 31). The photograph is captioned 'Camp at Elbow of the North Saskatchewan, Sept., 1871' at the Public Archives of Canada, but internal evidence suggests that this location is incorrect. Comparison of this with another photograph (Public Archives C27044) shows that both were taken near the same point, at the same time not far from Fort Carlton on the North Saskatchewan. The date was 1871, the year of the first railway survey in western Canada and a little more than a decade before the extinction of the bison. The camp belonged, no doubt, to what fur traders referred to as 'Post Indians', meaning Indians who lived, hunted for provisions or furs, and traded at a particular post.

The photograph shows six canvas tipis on the lip of the river bank. Near the closest white tipi is a tipi frame without a cover. Beneath the frame is an area of trampled grass with several white objects resembling bones. Immediately in front of the Red River cart is a similar area of trampled grass with a white circle res~~embling~~g a hearth toward one edge and other white splothes possibly indicating scattered bones. Presumably both areas of trampled grass were abandoned tipi floors.

In front of the sagging tent frame to the right of the Red River cart is a small pile of refuse. In profile the refuse is about 2 m long and about 25 cm high. This dimension includes the main pile but not the ash-white area to the right or the scattered bones to the left. The pile is mainly black. Whether the black represents one thing such as a crumpled piece of cloth or hide, or whether it represents several things such as decomposed meat, animal hair, discarded clothing and so on is not clear. Several white objects amid the pile appear to be fairly large pieces of bone.

The tents whose bases are visible have a floor diameter which ranges from about 3.6 m to about 5.4 m. In every case, the tent covering is pegged to the ground with pegs about 3 cm in diameter. The pegs protrude about 25 or 30 cm above the ground and are spaced all around the bottom of the tent at intervals of 30 to 40 cm. In addition, logs from about 8 cm to about 15 cm in diameter have been laid between the canvas and the pegs around the base of the tents (in one case, not continuously). Presumably, the logs provide an extra measure of anchorage to the tents.

The tent nearest the photographer and at the left of the picture has its doorway and smoke flaps facing left. The covering at the back of the tent has been pulled up creating a temporary opening about 1 m high. The ground surrounding this tent can be seen more clearly than that around any other. Large pieces of white bone are scattered thinly all round to a distance of 3 - 6 m from the base of the tent. There is a slightly more concentrated area of bones around the front doorway. Perhaps the most interesting feature in this picture lies at the photographers feet. What appears is perhaps one quarter of a large feature consisting of broken bones, a sooty black substance, and one piece of mottled hide or cloth. These are concentrated within an area demarcated by the black substance, but bone is also scattered outside this boundary to a distance of 1 or 2 m beyond. No grass can be seen growing within the black concentration; grass begins immediately where the black stops, growing up to the edge of the feature. The bones scattered outward lie upon grass. The bones are sufficiently concentrated in some places to make a solid layer for short distances, but elsewhere in the concentration small patches of ground can be seen between bones. In yet other places both bones and ground are obliterated by a black substance. All the bones appear to be thoroughly broken.

The difficulty in interpreting this feature is that it is not seen in relation to the full extent of the camp. Given this difficulty, it is assumed to be related to the visible tents and floor areas. The feature then appears to be a garbage disposal area for the camp; probably similar to Donaghy's "main bone pile, flattened out, with the large bones broken to get at the marrow". The concentration of white bones within the feature may be residue from a bone boiling operation. Other bones may have been stripped of flesh and broken for marrow, but not boiled. This condition would leave sufficient grease and flesh to create an unpleasant smell as the organic matter began to putrify. Other organic residue from butchering and processing meat, and from cooking might also have been deposited on the pile to keep the rotting (and stinking) material at a convenient distance from the living area. This explanation would account for the black substance.

The bones scattered around the camp might have come from two potential sources: the garbage pile just described and/or the remains of meals taken at tents. Dogs would probably have helped to scatter both.

In summary, the Horetzky photograph contains information on the distribution of bones in a historic Indian campsite. Two bone refuse piles can be seen. The smaller one is quite close to two abandoned tipi sites. The second is some distance away from any visible tipi. Both refuse piles appear to have similar contents including broken bone, a black substance, and pieces of hide. Bones can be seen scattered thinly around the whole campsite.

Archaeological Analogues

Bone refuse piles are not the type of feature discovered and identified often by archaeologists. But a study by Wheat (1972) shows how clearly bone features can be seen and how much cultural information they can supply when put under observation and analysis. Regrettably, the bone piles described by Wheat were in a kill site, were related directly to butchering, and are not analogous to those at the Harder site. At another site, the Cherokee Sewer site, bone concentrations which probably are analogous to Harder bone piles are mentioned

(Shutler and Anderson 1974:53) but not described. A search of central North America archaeological literature, relating to hunter campsites has so far revealed two relevant analogies.

Oxbow Dam site, 5200± 130 rediocarbon years, southeastern Saskatchewan (Nero and McCorquodale 1968)

The excavations at the Oxbow Dam site although small in extent were remarkably productive. Two features were discovered close together, one an ash-filled hearth and the other a scrap pile of bone and stone:

> ...Inglis probed horizontally into the soft layer of ash to a depth of from 18 to 24 inches, encountering a "scrap pile?" of bone and stone. His sketches show the position of two large granitic stones (about six inches in diameter) which he correctly designated as anvils, a "...top layer thick with flints - some bone fragments - charcoal and ashes," several large flint... flakes and large quantities of bone fragments.... One of the anvils was in the hearth but the other was off to one side along with most of the bone material and the large pieces of flint. The anvil in the hearth was surrounded by many small flint flakes, a clear indication that it had been used as an anvil where it was found. Inglis discovered in addition the tip of a projectile point, two side-scrappers, a finely retouched flake, and two flakes which appear to have been used as knives. (Nero and McCorquodale 1958:85)

The Oxbow Dam site concentration has similar ingredients to Harder site refuse piles, but lacking structural information it is impossible to confirm that the features are analogous, This is a common problem in seeking archaeological analogies.

Lungren site, estimated 4000-8000 years, southwestern Iowa (Brown 1967).

The whole excavated surface at the Lungren site has been described in terms of various features. Of the four features identified, three were dominated by concentrations of bone and two of these were called middens. Since the situation appears to be closely comparable to that at the Harder site, the brief descriptions of the features are quoted here in full.

> Feature 1 was a large midden situated near the western edge of the excavated area.... It was approximately 25.0 feet long, 0.2 foot thick, and varied in width from about 8.0 feet at the southern end to only a few inches at the northern end. The midden presumably covered a larger area to the west before stream erosion. It was made up of a dense fill of charcoal stained soil, broken and burned bone, fragments of bison mandibles, chipping refuse, and scattered charcoal.
>
> The excavated portion of the cultural deposit not included within Feature 1 was designated Feature 2. This area was composed primarily of tan clay sparsely impregnated with charcoal specks, bone fragments, artifacts and stone chipping debris. The majority of artifacts and stone chips in this area were situated in the western portion of the feature, close to Feature 1.
>
> Feature 3 was a boot-shaped configuration made up of a dense concentration of bone fragments, bison teeth, and charcoal. It overlaid a part of Feature 1 and was approximately 4.5 feet long, 0.1 foot thick, and ranged from 1.0 to 2.0 feet in width.
>
> Feature 4 consisted of a midden area and a fire pit situated in Feature 1. The midden was originally a thin layer of bone and charcoal overlaying the fire pit.... The fire pit was circular and basin-shaped. It was about 2.8 feet in diameter and 0.45 foot thick, and contained a fill of charcoal, burned earth, gray ash, small fragments of burned bone, and chipping waste. The fill was stratified, and was composed of six accumulated layers, each less than one inch in thickness. (Brown 1967:65-7)

Lungren Features, 1, 3, and 4 contain several elements similar to those that characterize the bone piles at the Harder site, such as broken bone, teeth and fragments of bison mandibles, charcoal stains, scattered charcoal, some ash, and chipping refuse. The size range of the two smaller features is similar to the Harder bone refuse pile, while the large midden called Feature 1 is comparable to the Large Area features at the Harder site. The thinness of the features at Lungren in comparison to Harder is likely a function of the clay matrix at the former site. An interpretation of the features beyond the designations, midden and fire pit, is not offered.

APPENDIX VII

ETHNOGRAPHIC AND ARCHAEOLOGICAL DATA RELEVANT TO DWELLING FLOORS AND OUTDOOR ACTIVITY AREAS

RELEVANT ETHNOGRAPHIC OBSERVATIONS

Lacking a definite idea about whether the Large Area Features might be inside or outside dwellings, I have examined certain ethnographic literature seeking information about construction and size of dwellings, articles kept inside and their arrangement, activities inside and outside dwellings, and other kinds of structures in camp in order to find analogies for the Harder site. Some relevant observations have already been presented in Appendix VI. Since the literature on Plains Indians refers to the same geographical area, it should be the best initial source of analogies for the Harder site. This does not imply that other analogies are not appropriate or useful (cf.Binford 1968). But since the Plains literature is quite full on these subjects, I have confined the ethnographic review to Plains studies. I use archaeological analogies from other areas later in this appendix.

The typical Northern Plains dwelling was the tipi of which there are a number of good descriptions showing variations of size and construction:

Blackfoot Tents, July 1859, southeastern Alberta.

> The Blackfoot tents are not only much larger than those of the Crees, but much better provided with internal accommodation, such as leather curtains to protect them from draughts, bedding, kettles, tin plates, and porringers, and in a great many cases with forks and spoons; the tents of the chiefs are about 20 or 22 feet in diameter; but there are some medium [medicine?] tents, or tents where the chiefs assemble in council, that are nearly 30 feet in diameter.... (Palliser quoted in Spry 1963:220)

Plains Cree tents 1860-1930, Northern Plains.

> The only dwelling was the hide-covered tipi, constructed on a three-pole foundation.... The poles were raised and the legs of the tripod extended. The rawhide line which tied the poles hung down and was staked to the ground inside the tipi. Upon this base thirteen poles were laid in counter-clockwise order. The total number of poles in the tipi frame varied with the size of the structure.
>
> ... After the cover had been pinned together, the woman went inside and shoved the tipi poles out until the cover was taut. The bottom of the cover was fastened to the ground by driving short wooden pegs through eyelets in the cover itself, or through looped thongs fastened to it.
>
> ... Twelve to twenty buffalo hides were used for a cover....
>
> ... A back wall of buffalo hide, similar to that used by the Blackfoot, lined the sides of the tipi. Hay was stuffed between this screen and the tipi cover, providing insulation in winter and preventing draughts. In the summer the bottom of the cover was rolled up on the poles to a height of about two feet from the ground.
>
> Ten or twelve people usually lived in a single tipi. The fireplace was in the centre, the place of honor being behind the fire, opposite the door. (Mandelbaum 1940:210-11)

Assiniboine tents, 1958, northern North Dakota.

> ...Other squaws were scraping the hair from the buffalo skins and dressing them to make new lodges, of which by the way very many families were sadly in need. Some had cut down their lodges little by little to supply pressing demands until there was barely enough left for a shelter. Sixteen skins sewed together with sinews, somewhat in the form of a cloak, and stretched over a framework of poles, form a very fair-sized lodge, sufficiently large to accommodate eight to ten persons with their effects.- But owing to the scarcity of horses among this band of Assiniboines and the necessity of using dogs as their beasts of burden, most of the lodges consisted of from six to ten skins only. (Boller 1972:139)

Drawing of the interior of a Cree Indian tent, March 1820, east central Saskatchewan.

An excellent drawing of the interior of a Cree tent was made by Lieutenant Hood 'to amuse the Indians' in March 1820 (see Plate 32). In it we see six adults, one adolescent, and one baby around a central fire. Guns and bows and arrows are leaning against the walls. There is no interior tent liner or double wall. The adults are sitting on robes, Hudson Bay blankets, or on the bare dirt. A pole, suspended across the fire, does double duty as a support for a metal pot over the fire and also as a drying or smoking rack for two strips of meat.

Drawing of Interiors of Cree skin tent and Ojibwa birchbark tent, October 1858, west-central Manitoba.

A composite drawing with profile views showing the interiors of both birchbark and skin tents, with people sitting around a central fire, fish-nets or meat suspended on poles over the fire, and with various tools hanging from the lodge poles, is provided by Hind as part of the description of tents he visited near Manitobah House in October 1858 (see Plate 33). In addition he left the following description of the interior of the birchbark tent he stayed in overnight.

> His birch-bark tent was roomy and clean. Thirteen persons including children squatted round the fire in the centre. On the floor some excellent matting was laid upon spruce boughs for the strangers; the squaws squatted on the bare ground, the father of the family on an old buffalo robe. Attached to the poles of the tent were a gun, bows and arrows, a spear, and some mink skins. Suspended on cross pieces over the fire were fishing nets and floats, clothes, and a bunch of the bearberry to mix with tobacco for the manufacture of kinni-kinnik. (Hind 1971, Vol. 2, p.63)

Feasting inside an Assiniboine tent, 1858, northern North Dakota.

> When the feast was ready the camp was harangued to call the soldiers to it. In a little while they came, each one bringing his bowl and cup, and the lodge was soon crowded to its utmost capacity. All sat with their knees huddled up to their chins and deep in communion with their own thoughts.
>
> ...There were over thirty men crowded in that lodge during the feast, where there seemed barely room for four or five to move about comfortably. (Boller 1972:140-1)

Sioux tents-all cookery done inside, c.1775, plains between Missouri and Mississippi Rivers.

> They Leade a wandring Life in that Exstensive Plane Betwen the Miseeurea & Misisippey thay dwell in Leather tents Cut Sumthing in form of a Spanis Cloke and Spread out by thirteen [poles] in the Shape of a Beel the Poles Meet at the top But the Base is fortten in Dimert [diameter] thay Go into it By a Hole Cut in the Side and a Skin Hung Befour it By way of a Dore thay Bild thare fire in the Middel and [d] ue all thare Cookerey over it at Night thay Lie down all round the Lodg with thare feat to

the fire [sic] (Pond 1965:57)

Fireplace, associated cookery, and fuel, Hidatsa hunting camp, c.1869, Yellowstone River

Our fireplace was in the centre of the tipi on the level ground. Five or six stones were placed around the fire; upon these we roasted meat. We never used white stones, for they cracked with the heat. The stones were placed far enough apart so we could roast the thigh bone of a buffalo before the fire (fig. 89). We cut the rough outer flesh from the thigh, leaving the more tender flesh still clinging to the bone, and this was laid near the fire, the two ends resting on two stones. When the meat was roasted and had been cut off, the bone was cracked open and the marrow pried out with a chokecherry stick and eaten with the meat. ...

The fireplace was surrounded by stones only when wood was scarce and buffalo chips were used for fuel, but when it was abundant the kettle was set directly on the coals and the meat roasted on wooden spits. When we camped on the prairie, however, we could obtain no wood, and made our fire of buffalo chips. In that case, we roasted our meat on stones. (Buffalo-bird-woman quoted in Wilson 1924:268)

Grass mattresses, Plains Cree, 1860-1930, Northern Plains.

Beds were made of bundles of dried grass or rushes over which a buffalo robe was thrown. During warm weather, the robe alone sufficed. (Mandelbaum 1940:212)

Grass mattresses changed occasionally, Cree, 1820, Fort Carlton.

We found seven tents pitched within a small cluster of pines, which adjoined the pound. The largest, which we entered, belonged to the chief.... As we had been expected, they had caused the tent to be neatly arranged. fresh grass spread on the ground, buffalo robes were placed on the side opposite the door for us to sit on, and a kettle was on the fire to boil meat for us. (Franklin 1970:109-10)

Temporary shelters used by Plains Cree, 1860-1930, Northern Plains.

Several types of temporary shelter were made. One was constructed by stacking boughs in conical form or by leaning them against a convenient tree. In summer, women still do their work in a shelter. Where boughs could not be obtained, rawhide was placed over the foundation poles.

Hunters erected a windbreak by stretching a robe between two upright poles. ...

A semi-cylindrical structure fashioned of a series of willow arches, connected by long rods at the top and sides, was set up when tipi poles were not available. The structure might also be hemispherical and built like a sweatlodge. The frame is covered with an ordinary tipi cover or with boughs. A smoke-hole was

> left open at the top in both types. (Mandelbaum 1940:212)
>
> Ceremonial structures made by Plains Cree, 1960-1930, Northern Plains.
>
> The sweatlodge was dome-shaped, about four feet high and six to eight feet in diameter. Six holes dug in a circle served as sockets for willow withes which were arched over and intertwined in opposite pairs. Robes, blankets, or tipi covers were laid over the frame. The covers were lifted to gain entrance. A circular hole was dug inside the lodge to receive the heated stones. A sweatlodge could only be used once. ...
>
> A house form used only for certain dances is the sapohtowa.n, which may be literally translated as "going right through tipi," i.e., long tipi. It is a long ledge with apsidal ends. Two tripods, made of poles forked at the top, were set up about twenty-five feet apart. The poles of each tripod were fastened together by interlocking the forks and not by lashing as in an ordinary tipi foundation. A ridgepole laid on the tripods was further supported in the middle by a pair of forked poled interlocked at the point where they joined the ridge pole. Two or three pairs of supports may be used. Ordinary tipi poles were laid against the ridge pole and in a semicircle around the two tripods. Tipi covers of brush were placed over the lower part of the frame, the upper portion remained open. A fire was built beneath the apex of each tripod. A space was left for the door at one end, usually toward the south.
>
> A structure used only for certain dances was wewahtahoka.n, literarlly, "joined together tipi." It was a tipi framwork so large that two covers were needed to enclose it. No doorway was made; entrance was obtained by lifting the cover. For the Smoking Tipi ceremony, a special wewahtahoka.n was constructed. Four foundation poles were fastened together by interlocking their forked tops and binding with thongs. Additional poles were laid and two tipi covers drawn over this framework.
>
> While the common tipi was erected by women, these ceremonial structures were set up by men. (Mandelbaum 1940:212)

Several ideas relevant to the distribution of materials inside and outside dwellings (or more generally, structures) of historic Northern Indian camps can be extracted from these quotations. The first thing is that the commonest and most widespread structure was some form of tipi. Mandelbaum (above) states that, except for temporary dwellings which might be used by small groups temporarily away from the main camp, the tipi was the only dwelling structure used. The size of tipis seems to have varied a good deal, with average diameters of both 4.2m and about 6.3m being mentioned. Boller (above) suggests that while 16 skins made a good sized tent, (presumably about 6 m in diameter), Indians who had only dogs to carry baggage were reduced to tents of six to ten skins. A reduction of skins from 16 to about eight per tent might result in a corresponding reduction of one third to one half less diameter, of a diameter of 3 to 4 m. The large area features at the Harder site range from 5.25 to 13.4 m.

Turning away from the average situation for a moment, it should be remembered that there were also smaller and larger dwelling structures. The usual explanation for smaller tents among the average-sized ones is that some Indians were poorer than others. Boller's comment (above) makes better sense; and suggests that the same family, periodically, had both large and small tents. The family started with a large new tent and as leather was needed from time to time, pieces were cut from the cover, gradually reducing its size. Eventually, when the tent cover became too small, it had to be replaced. Larger structures, including large tipis (see Palliser above) and large ceremonial and dancing structures (see Mandelbaum above), seem to have occurred regularly, but in small numbers in most camps. Large structures usually occupied a central position in the camp.

Descriptions of the erection of tipis and other structures (see Mandelbaum above) make it clear that in most cases there should be no archaeological evidence for the framework. The tipi poles rested on top of the ground so they should leave no trace. The central peg mold inside the tent would probably be obliterated among the other internal evidence. The smaller pegs around the base of the tent would leave an archaeological impression only under very unusual conditions such as peg molds in damp clay, which hardened when dry and then were filled with material of a different colour or texture. The lack of evidence for structural members would not matter, however, if the structure could be defined by the shape of the remains of activities confined within it.

It is to the considerable disadvantage of archaeologists that during much of the year walls of tents did confine activities within, because walls could be rolled up and down (see Mandelbaum quote and Fort Carlton photograph). This situation means that the detritus of various activities could spill out or be pitched out of the tent in any direction, not just around the door. Consequently, lacking evidence for structural members we cannot simply substitute the dimension of a concentration of debris for the dimensions of an assumed structure in which the debris was supposedly laid down. If the site had been occupied only during the coldest winter months this might be an acceptable procedure, based on the assumption that the walls would not have been rolled up and would have confined the waste materials within the diameter of the tent. During the milder months, however, walls may have been rolled up and down many times in tune with weather and housekeeping requirements, so that debris would be spread over a larger area than that covered by the dwelling.

The only feature consistently mentioned in historic observations which should show up in the archaeological record is the central fire place. The Hood drawing of the interior of a Cree tent includes the details of the fireplace. It appears to be an unprepared, unbounded hearth at floor level. Pieces of firewood have been laid on the firebed so as to radiate out from a small central circle. Ashes, coals, and unburnt wood could be continually pushed toward the centre, thus containing and maintaining the fire in one operation. Ash, especially, would be produced in quantity by such a fire. A good deal of ash and charcoal around the edges of the fire would probably move outwards in all directions across the floor over a period of time, due to the movements of people. This would happen even if ash in the centre of the fireplace were periodically brushed up and carried to a garbage pile outside the door or farther away. On abandonment of the site the ash and charcoal left on the surface might be blown away quickly by the wind, but one suspects the ash and charcoal mixed with soil of occupation on the floor of the tent would remain. Also remaining would be soil stains due to the heat of the fire - iron oxides have a tendency to turn a reddish hue when heated. Soils containing iron oxides thus preserve an impression of the hot area of a hearth.

In the Harder site, the only soil stain and ash concentration that we could confidently identify as being a fireplace was situated in an isolated excavation unit that revealed only three square meters of occupation surface of the Feature 13. The other (Type 1) large area features all contained black-grey soil believed to contain carbonized material and ash. The presence of carbonaceous-ashy soils, alone, cannot be taken as proof of the presence of a fireplace in the immediate vicinity. It could be fireplace refuse carried away from the fireplace to a garbage pile. There is, on the other hand, an equal chance that the carbonaceous-ashy material is still in direct association with an unexposed fireplace. This dilemma underlines the value of large exposures at archaeological sites.

Buffalo-bird-women's recollection (above) about her own tipi fireplace confirms the ground level construction shown in the Hood drawing (Plate 32). No doubt various forms of fireplaces involving a pit were also used but the level-with-the-ground type seems to have been common.

Buffalo-bird-woman's generalization that five or six outside prop or roasting stones were used when buffalo chips were fuel but not when wood was fuel conforms with the Hood drawing.

An important part of the Buffalo-bird-woman observations about the fireplace concerns roasting buffalo thigh bones. She says that the thigh bone with some tender meat still on it was roasted by the fire, then meat was cut off and bone cracked open for marrow. Assuming that this small scale bone breaking took place inside the tent at the edge of the fire or nearby, one would expect that large and small bone fragments might wind up scattered around the floor and in the fire. The extent to which these fragments would be allowed to lie where they fell would depend on the housekeeping habits of the occupants. At the Harder site, large and small bone fragments were scattered throughout the large area features (particularly Type 1).

The descriptions of grass mattresses were included to raise the possibility that a large part of the floor inside a dwelling might have been covered, thereby protecting it from deposition due to occupation and thereby producing an area that would show up as being archaeologically sterile. The remains one might then expect would include a central hearth, a small surrounding area full of occupational detritus, and beyond that a large surrounding area that was either completely sterile or comprised of patches that were completely sterile. Nothing comparable to this description was found at the Harder site. Either our deduction about the resulting surface remains after use of grass mattresses is incorrect, or else they were not used at the Harder site. The possibility that we have not yet encountered dwelling floors at the Harder site cannot be discounted but it seems remote.

To this point I have considered archaeological remains and ethnological observations mainly from the inside of the tent. The emphasis on activities inside tipis seems to be a reasonable reflection of the apparently large amount of camp time that historic northern Plains Indians devoted to indoor activities. Even in good weather they preferred to crowd into a tipi rather than eat outside (see Boller above). It is not too surprising to learn that meat was processed inside the tents during winter, but I was surprised to read about large scale meat processing inside tents in mid-summer as reported by H.Y. Hind (see above). Perhaps this practice was due more to preference for smoked meat and convenience than to a simple desire to work inside, but one cannot fail to recognize what a multipurpose structure the tipi was, and how it tended to be the focal point of activities. The tipi seems to have been dwelling place, workshop and drop-in centre all in one. For the sake of completeness, however, activities and features that occurred outside the tipis but still within the campsite are also considered.

Several types of ceremonial structures were constructed for special religious events. Mandelbaum (see above) describes some of the smaller ceremonial structures. As with tipis, the super-structures probably left little or no archaeological remains. In addition, specialized activities which took place in such structures seem to have required little internal apparatus. One or two ground level hearths with ash and a relatively clean surrounding surface might be all that remained in the archaeological record. Large ceremonial structures such as a sun dance lodge (Mandelbaum 1940:265-71) might be recognizable as a very large pattern of post-molds. The location of ceremonial structures was generally in the centre of the campsite (for example, the sun dance lodge structure in Plate 34), a situation which might aid identification of such a feature found in large scale excavations.

All activities which took place inside a tipi could probably also have taken place outside. The previous quotations show that meat processing could be done inside a tipi, in the doorway and outside. The same was true of tanning hides, visiting, and cooking. There seem always to have been options available to suit the circumstances. Hungry Wolf (1972:10) notes, for example, that when a cooking fire made a tipi unbearably hot, the women either pulled out the tent pegs and rolled the lodge cover up a few feet, or moved out of the tipi and made themselves a temporary cooking and sun shelter. Sometimes they simply tied a few poles together and draped part of an old tipi cover over them, and sometimes they built more elaborate shelters with a framework of poles covered with pine boughs. The second option, would probably result in a combination of archaeological remains such as a fireplace, carbonaceous-ashy soil surrounding, bone pile and bone and chipping debris scattered about, that would be difficult to distinguish archaeologically from the remains of the tipi floor nearby. From this discussion it can be seen that determining the relationship of a concentration of remains to the inside or outside of a dwelling is a complex exercise.

Relevant Archaeological Observations from Other Sites

No doubt many concentrations of bone, stone, and ashy soils found in archaeological sites are relevant to the Harder site large area features. Hunting and gathering societies were a world-wide phenomenon for most of human history. In view of this fact, one would think that there should be an enormous reservoir of archaeological evidence available for comparative purposes, but there is not. Only a few hunter-gatherer sites have been completely or largely excavated. Three sites contain Large Area Features throwing comparative light on the Harder site as described below. One is older and located far outside the present study area, one is younger and can be found within the study area, and the third is about the same age and in a similar geographic location.

Kostenki XIX site, terminal Wurm (ca. 15,000-10,000 B.P.?), on the bank of the Don River in the eastern part of European Russia.

A series of 24 open-air Upper Paleolithic sites in eastern European Russia, sometimes referred to as the Kostenki-Borshevo sites, have been the subject of intensive, high-quality investigation by Russian prehistorians for several decades (Klein 1969). This series of sites offers a remarkably undisturbed and extensive picture of the habitations, subsistence activities, technology, decorative and artistic proclivities, burial practices, and even some aspects of the intellectual life of Upper Paleolithic hunter-trappers outside the well known Perigord in southwestern France. Instead of the reindeer quarry, these people based their subsistence on other gregarious large game, principally woolly mammoths and wild horses, and on fur-bearers like wolf, arctic fox, and hare. At several sites in the series, the remains of habitations allow convincing interpretations of the original structures, based on the distribution of a complex of bone, chipped stone, carbonaceous ashy soils, hearths, small internal pits, and a great variety of bone and stone tools. At Kostenki XIX, however, the boundaries of the habitation features while not as clear as at some of the other sites appear to be quite similar to those of the Harder site.

Excavations at Kostenki XIX exposed 217 m^2 of a single occupation surface (see Fig. A.VII.1). Cultural remains were found throughout a cultural horizon that averaged 15-20 cm in thickness; and, except for

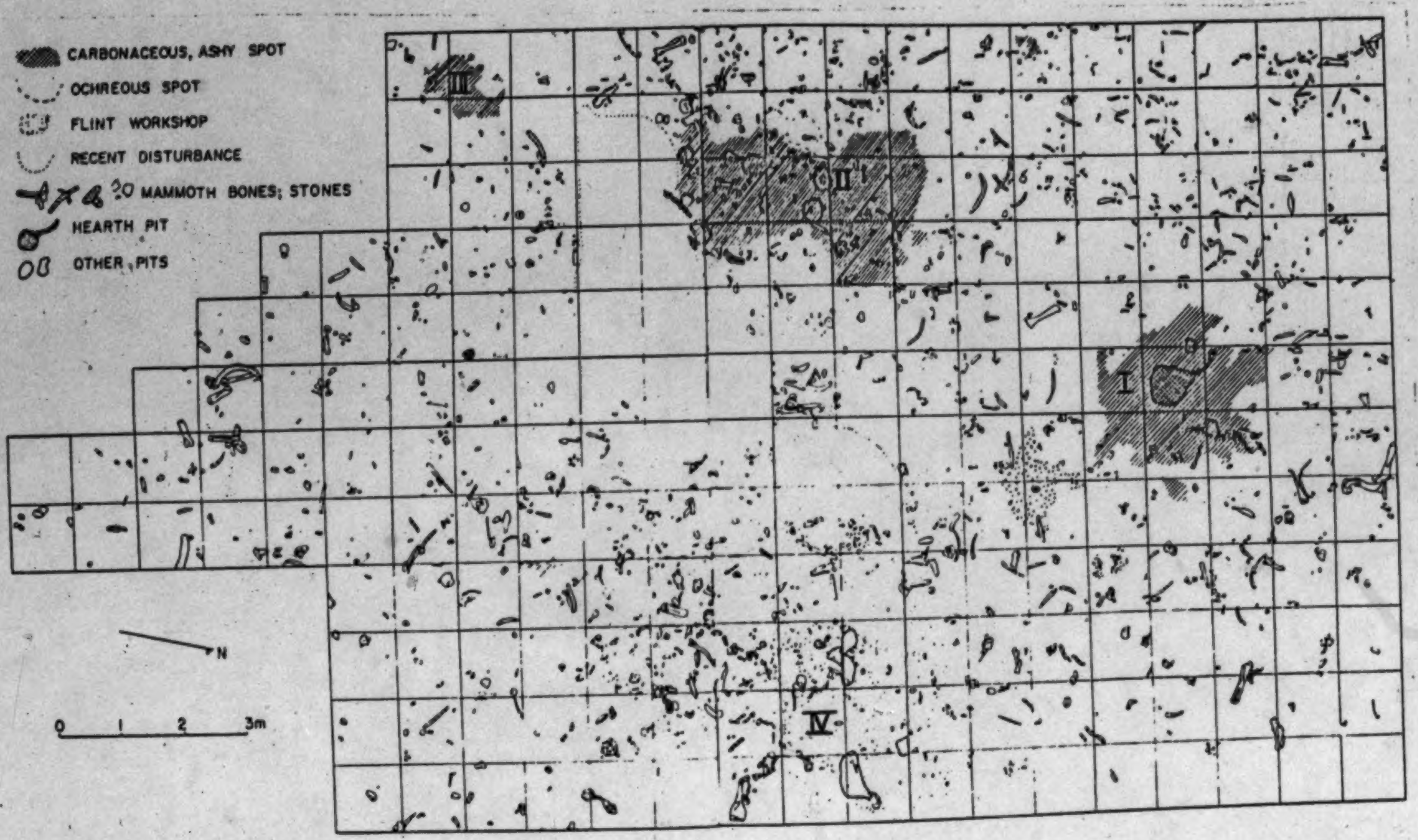

CARBONACEOUS, ASHY SPOT
OCHREOUS SPOT
FLINT WORKSHOP
RECENT DISTURBANCE
MAMMOTH BONES; STONES
HEARTH PIT
OTHER PITS
I
II
III
IV
N
0
1
2
3m

Fig. A.VIII.1 Plan of Kostenki XIX (after Klein 1969: Fig. 67) minor disturbance by local farmers, the remains were in situ. Six test pits outside the main excavation area showed the north-south limits of the site coincide with the limits of the main excavation. The soil matrix was loam. Concentrations of material were found in four areas, labelled Complexes 1, 11, 111 and IV (see Fig. A.V111.1). Complex 1 consisted of a flat, unevently bounded accumulation of ashy matter, 1 - 2 cm thick, and covering about 4 m^2. Located centrally was a 'tailed hearth', 60 - 70 cm across, about 25 cm deep, with vertical sides and a channel or tail to one side believed to improve air flow to the fire. The hearth pit was filled with ash, charcoal, burnt bone, large grains of red pigment, a few flints (flakes), and a number of pieces of burnt and unburnt loam. Around the edges of the hearth were some small fragments of burnt bones, a few small lumps of red pigment, a fragment of belemnite (fossil invertebrate), and 29 flint artifacts. Two small pits believed to be postmolds were found on opposite sides of the hearth. It has been tentatively suggested that Complex 1 marks the location of a relatively temporary hut supported by wooden posts.

Complex 11, located 4 m southwest of Complex 1, consisted of: (1) an irregular accumulation of ash, charcoal, small fragments of burnt bone, and lumps and grains of ochre covering approximately 10 m^2 and averaging 4 cm in thickness: (2) an ochreous strip of loam 1.3m long, 0.4 - 0.5 m wide, and 2 cm thick, and fired-red spots at several other locations beneath the ash accumulation; (3) a cluster of five small pits, 30 cm across and 10 - 20 cm deep, filled ash, charcoal, bits of red ochre, and occasional flints, and believed to have been post holes; and (4) some mammoth long bones driven or dug into the loam surrounding the complex so that the upper end of each are thought to have provided support for additional posts. Complex 11 is also thought to be the location of a relatively temporary hut supported by wooden posts.

Complex III, located 3 m south of Complex II, consisted of an irregularly shaped accumulation of ash, small fragments of bone, and bits of red ochre. The ashy matter covered an area of approximately 1 m^2 and averaged 1 cm in thickness. No pits were found below it and no interpretation of this feature has been offered.

Complex IV, located 4 m east of Complex II, covered an area of about 16 m^2. It consisted chiefly of a massive concentration of flint artifacts, especially small chips for retouching. Several squares near the centre contained more than 1,000 flints each, but the numbers of flakes per unit decreased markedly toward the peripheries of the complex. Some of the flints had been exposed to fire. One hearth, centrally located, consisted of a small vague spot of carbonaceous matter, several dozen centimeters in diameter and up to 5 cm thick. It also contained several lumps of ferruginous rock and was underlain by spots of fired-red loam. A group of seven small pits, 15 - 20 cm deep and filled with flints and charcoal, lay beneath the northern part of the complex. It is supposed that these may have been caches. The whole complex is interpreted as a flint workshop.

The areas between complexes were generally poor in ochre, charcoal and burnt bone. Only one hearth occurred outside the complexes, located immediately south of Complex IV. No pits were found anywhere outside the complexes. No detailed interpretation of the complexes as a group has ever been attempted. Klein (1969:198) suggests that this failure may be because it is not possible at present to demonstrate that they originated simultaneously.

Stone Tipi Rings. Stone tipi rings are a well known archaeological manifestation of the Plains Indian tipi, but even tipi rings are a source of some disagreement and reserved judgement among people who have examined them closely. Wedel's description of the distribution, situation and composition of tipi rings is a good one.

> Among the most abundant and widespread antiquities of the Northwestern Plains are those commonly known as tipi rings. These are found in limited numbers in northern Colorado and extreme western Nebraska, and more frequently in the Dakotas eastward approximately to the Missouri River from Fort Randall northward; but the greatest numbers appear to be in Wyoming and Montana, with many additional occurrences in southern Alberta and Saskatchewan. They are found on river bottoms, on stream terraces at varying heights, on the upland margins, and on elevated ridges and spurs, sometimes at considerable distances from visible existing sources of water and wood. Characteristically, they consist of boulders and field stones, from a few inches to a foot or more in diameter, placed at intervals to form circles from five to over forty feet in diameter. Often these boulders are embedded in the sod and give the impression of considerable antiquity. Some rings have a small cluster of stones near the centre suggesting a fireplace, and similar clusters sometimes occur just outside the circles. The rings often occur singly, but may be found in groups of almost any number up to two hundred or more. Artifacts and camp rubbish are usually extremely scarce in and around the rings, so that their assignment to any specific time period, tribe, or culture is not easy. (Wedel 1961:262)

The name tipi ring is based on the supposition that the stones were used as weights, in place of, or in addition to wooden pegs, in order to anchor the skin cover of a tipi. Kehoe (1960) in a comprehensive review of ethnological data and historical documents has demonstrated that the use of boulders to hold down tipi covers among such tribes as the Blackfeet, Cree, Crow, and Dakota was common practice. Since much of Kehoe's evidence consists of eyewitness accounts, including the association of a specific family with a particular tipi ring, the function of the stone rings as lodge cover weights would seem confirmed. This being so, one might expect to get a good idea of the internal archaeological remains inside a tipi (in order to be able to recognize a tipi floor without the stone ring) by applying the usual archaeological excavation techniques to a tipi ring and its immediate locale. A number of people (Mulloy 1958, 1965; Malouf 1961; and Frison 1967) have investigated the interiors of tipi rings and have received very meagre returns for their efforts. The paucity of evidence for occupation within tipi rings has led Mulloy (1958) to question the idea that stone rings were indeed once associated with tipis.

> The writer has heard reports of hearths in "tipi rings" but he has never seen any evidence of either fire or a hard packed floor either in, or associated with any example. Perhaps most convincing is the paucity of artifacts and lack of evidence of household activity on these sites...Any habitation group of as many lodges as circles could scarcely avoid leaving much more than is usually found, even if the occupation were very temporary. ...
>
> It is suggested that the stone circles are part of a complex which had a ceremonial rather than a practical function. They may have been erected as shrines, dance areas, or for some more obscure prupose. (Mulloy 1958:212-13)

Kehoe (1960) has considered the negative evidence against the tipi ring interpretation, and in regard to fire makes two observations: (1) there is frequent evidence of fireplaces in the form of rock concentrations and rock-lined hearths in the centre of some tipi rings; (2) the absence of ash and charcoal within tipi rings can be explained on the grounds of scattering by the wind when the lodge was removed, and by frequent outdoor cooking during pleasant weather. In regard to the absence of hard-packed floors, he suggests that it is not realistic to expect a hard-packed floor to develop on tough prairie sod during a brief occupancy. Kehoe's explanation for the paucity of artifacts is that, "since tipi rings were occupied for only a short time by nomadic people who would discard very little, an abundance of habitational debris is not to be expected." (Kehoe 1960:456) This last explanation just does not seem to set the matter to rest, since the short occupation of tipi rings has not been established.

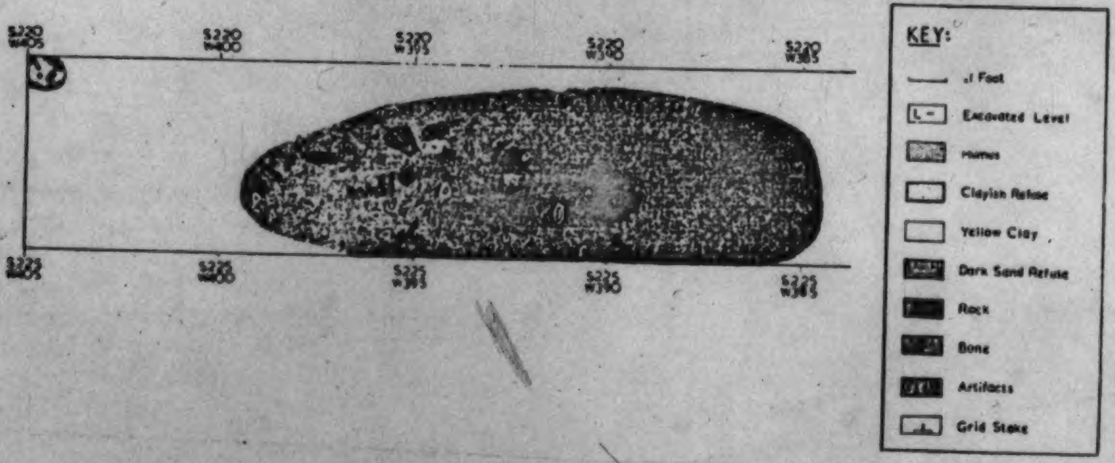
G. Frison has carried the question of the usual absence of artifacts somewhat further. The absence of perishable remains (including bone), he suggests (Frison 1967:25), may in some cases be accounted for by the fact that many of the rings are located on geomorphic features where erosion or deposition has been almost non-existent since the site was abandoned. Exposure to centuries of animal movements and the elements has probably destroyed or changed all but the most imperishable artifact material. This explanation, however, does not account for the absence of materials such as chipped stone debitage or broken stone tools. At the Piney Creek Sites, Frison found not a large amount of artifacts in the stone rings he excavated, but more than is usually found. These rings are located near a successful buffalo kill, a circumstance which Malouf (1961) has earlier noted usually coincides with increased trash in associated stone rings. The implication is that there is variation in the amount of observed artifacts in tipi rings and the variation is related to activities associated with but outside the tipi ring site. Frison also suggests, logically, that variation in the number of artifacts present may be related to the duration of occupation, which in turn may be related either to the success of hunting or to the season of occupation. Finally, referring to Mulloy (1965), Frison does not rule out the possibility that some stone rings may be related to something other than tipis used as family dwellings - he recommends the severe limitation of any broad generalizations about stone circles.

It appears that there is room for additional research on tipi rings, in particular, the variation in the amount of artifacts from one site to another. We shall probably not see new dissertations on the topic in the near future, however, for as Frison (1967:25) has pointed out, "discouragement comes quickly in investigation of a stone circle site where artifact material and anything else of interpretive value is scarce and usually contained in an almost impenetrable mass of grass roots that must be torn apart piece by piece with difficulty." In the meantime, the general paucity of artifacts and rubbish both inside and outside stone rings seems of little aid to interpretation of relatively dense concentrations of material in buried campsites.

The Larter site, estimated 1500 B.C. - 550 B.C., Red River in southeastern Manitoba.

During the summer of 1951, R.S. MacNeish (1958) excavated part of the Larter site (EaLg-1) which is situated on the west bank of the Red River several miles north of Winnipeg. The surface of the site produced traces of a late ceramic complex which MacNeish called the Manitoba focus. However, the main target of excavations was another group of materials which appeared on the surface of the site and also undisturbed beneath it. The second complex is preceramic and contains a variety of projectile point types which MacNeish named Larter Tanged, Anderson Corner-notched, Parkdale-eared, McKean Lanceolate, Winnipeg Ovoid, and Sturgeon Triangular. It appears that the type "Parkdale-eared" is similar to the type known elsewhere as "Oxbow". With the exception of the Manitoba focus materials, in analyzing the artifacts collected at the Larter site, MacNeish treated all materials as if they belonged to a single cultural complex which he named the Larter Focus. Having already excavated the Lockport site to establish the sequence of prehistoric complexes in southeast Manitoba, MacNeish's work at the Larter site was for the purpose of "filling out the picture of a particular part of the prehistoric sequence" or "to throw light on the way of life" of a particular time period.

One of three features exposed in excavations is particularly relevant to Harder site large area features. Feature 1 was a small pit, in a corner of the excavations, containing cracked and split buffalo bones. Feature 2, a lens of ash containing fire-cracked pebbles, was believed to have been a roasting pit. It was situated near the centre of Feature 3, also called Floor 1 by MacNeish, which was an 11 foot long, one inch thick, oval of dark grey soil littered with broken, split and cracked bison bones, whole and broken chipped stone tools and debitage, and a partially-grooved hammerstone. Faunal remains were 95% buffalo bones, 1% bird bones, 2% shell, and 2% mammal bones other than buffalo (deer, bear and possibly rodent). No skulls or vertebral fragments appeared on Floor 1. A few bones were burned and many bones showed signs of interior scraping. Chipped stone tools within Feature 3 included one semi-lunar knife, 11 projectile points, eight of which were whole, parts of two large choppers, and a huge scraper. Feature 3 appears similar to the large area features at the Harder site. Figure A.VII.2 shows MacNeish's Floor 1 plan view.


S220 W405
S220 W400
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S225 W405
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S225 W385
KEY:
.1 Foot
Excavated Level
Humus
Clayish Refuse
Yellow Clay
Dark Sand Refuse
Rock
Bone
Artifacts
Grid Stake

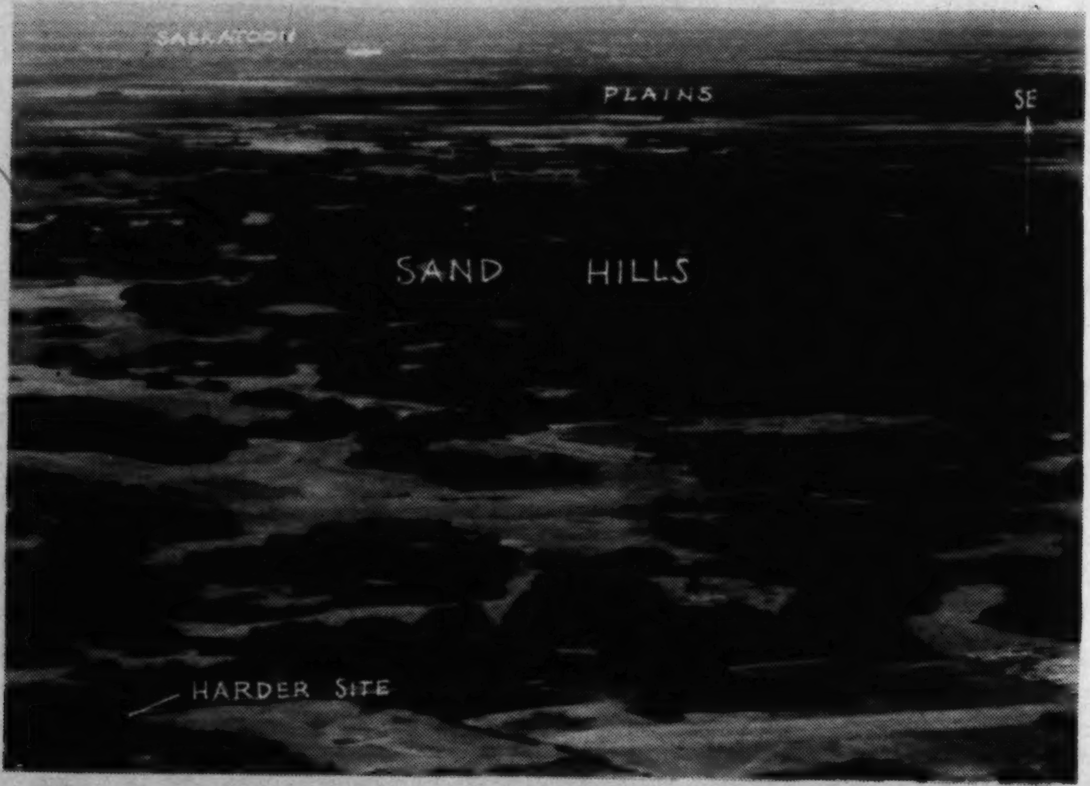
Fig. A.VIII.2 Ground Plan of Floor 1 at the Larter site
(after MacNeish 1958: Fig. 8)

MacNeish's interpretation of Floor 1 is that it was:

> ...an occupation level, on which the results of a buffalo kill were cut up for use. The actual slaughter probably took place elsewhere as no heads or vertebral fragments appeared. Apparently only those bones to which meat adhered were brought to Floor 1. Carried in the flesh were some of the projectile points used in the kill. After the butchering was finished, evidently the area was left (possibly because of the stench), and after a time yellow soil was washed over the floor by rain and the like. (MacNeish 1958:35)

In conclusion, the Larter site analogy shows that features, apparently similar to those at the Harder site are found elsewhere in the Northern Plains, but are difficult to compare because they have not been completely exposed or interpreted in relation to other features. On the other hand, tipi rings where the relation of the rings to internal features and to other rings is quite evident, have a paucity of materials other than stones making comparison difficult. The most comprehensive archaeological analogy comes from Kostenki XIX where a large area of occupation surface was exposed and several concentrations of soil stains, bone and stone debris were found.

APPENDICES


SASKATOON
PLAINS
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SAND HILLS
HARDER SITE

Plate 1. Oblique aerial view of Harder site and Dunfermline Sand Hills from northwest.

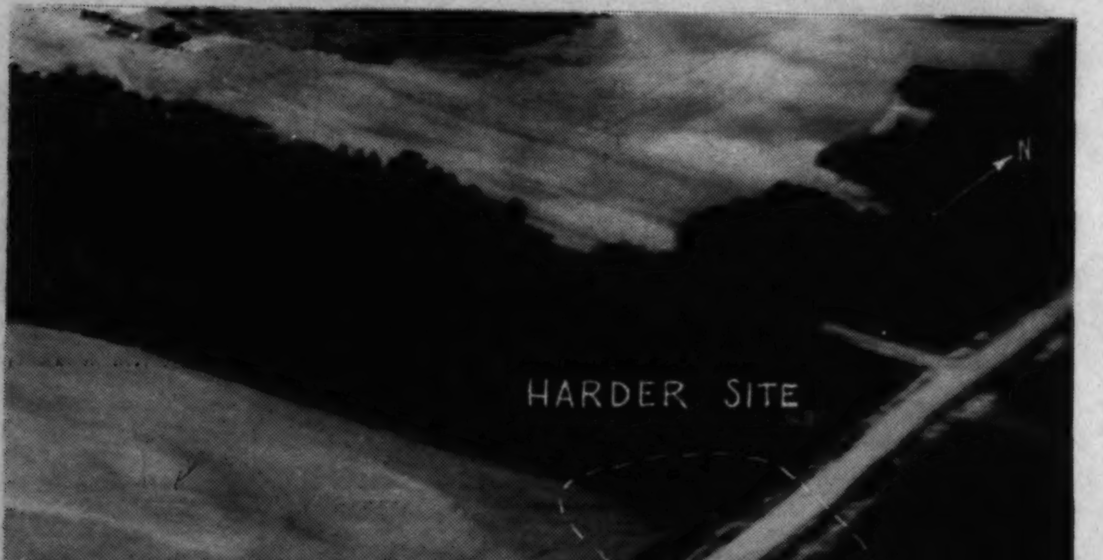
N
HARDER SITE

Plate 2. Oblique aerial view showing dune depression in which Harder site is situated.

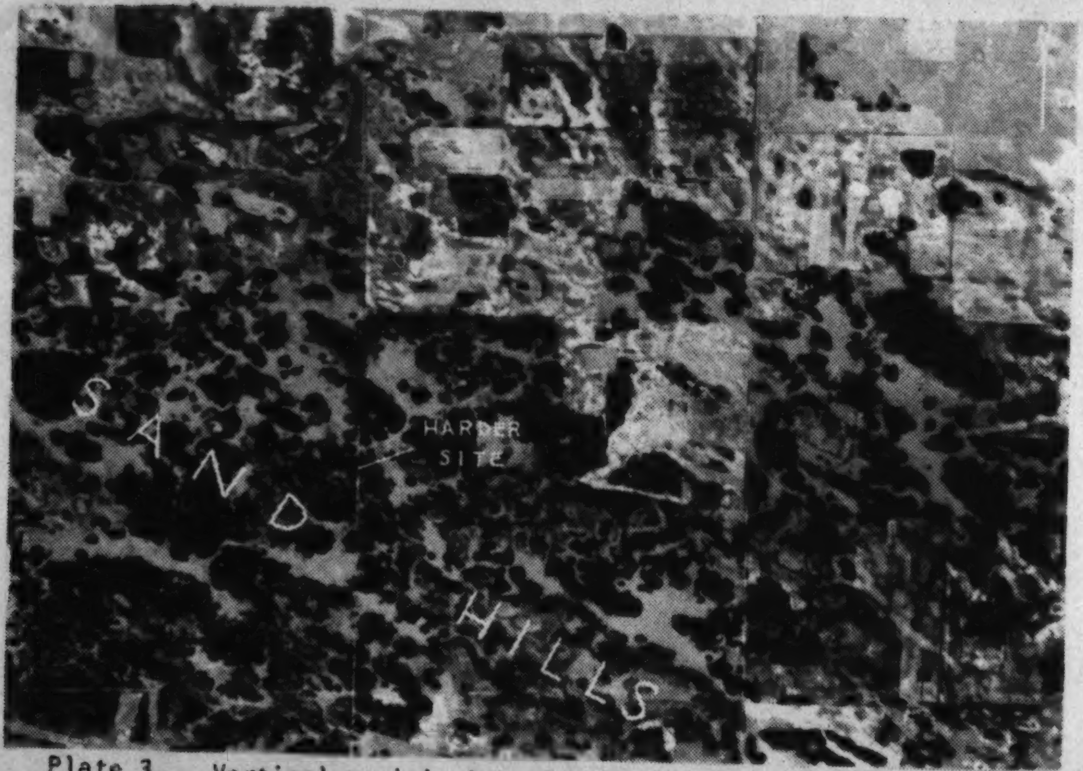
HARDER
SITE
SAND
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Plate 3. Vertical aerial view of Harder site locale, late 1930s.

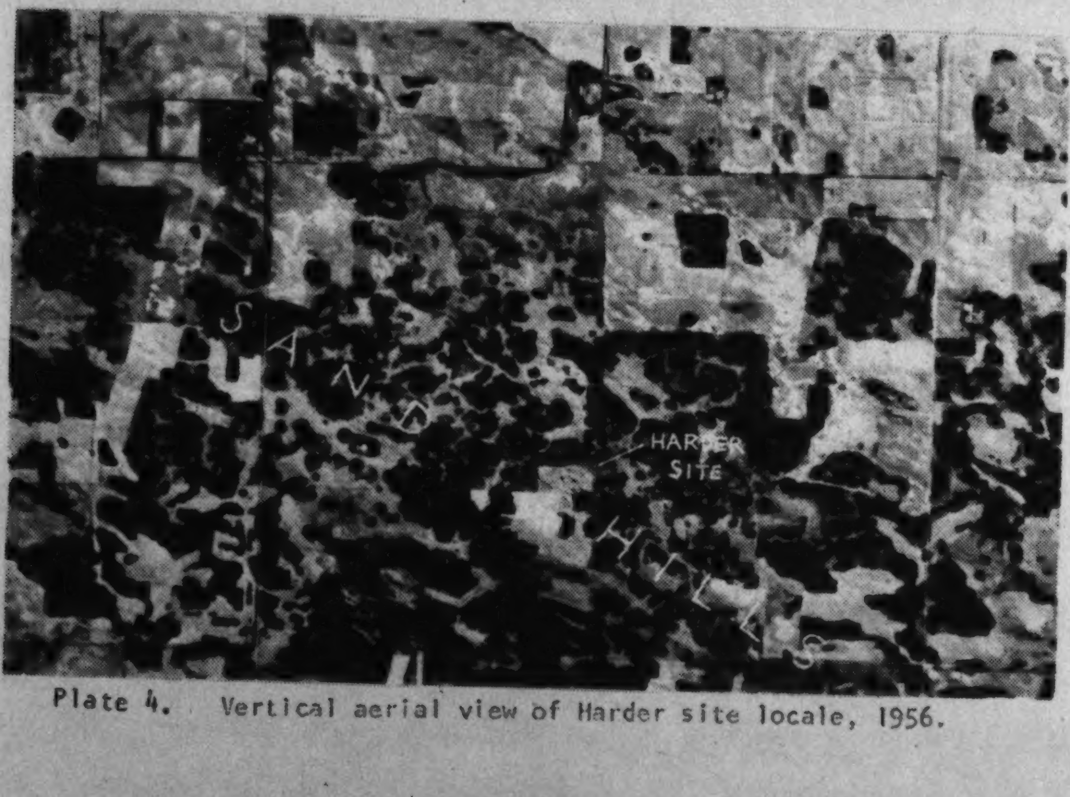
SAND
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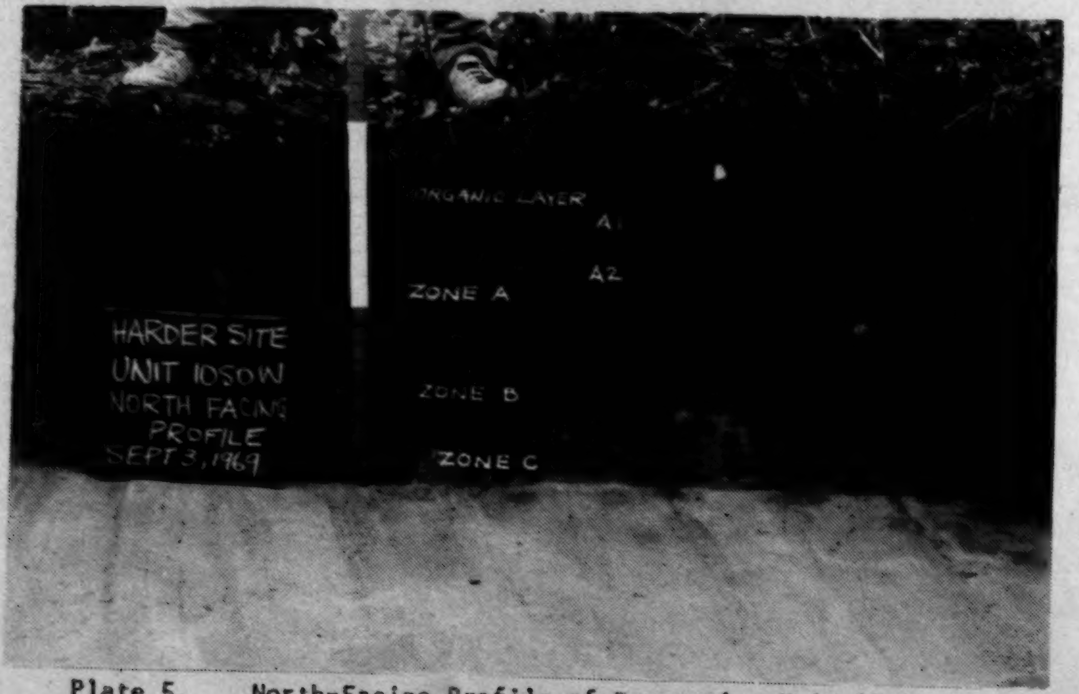
Plate 4. Vertical aerial view of Harder site locale, 1956.


ORGANIC LAYER
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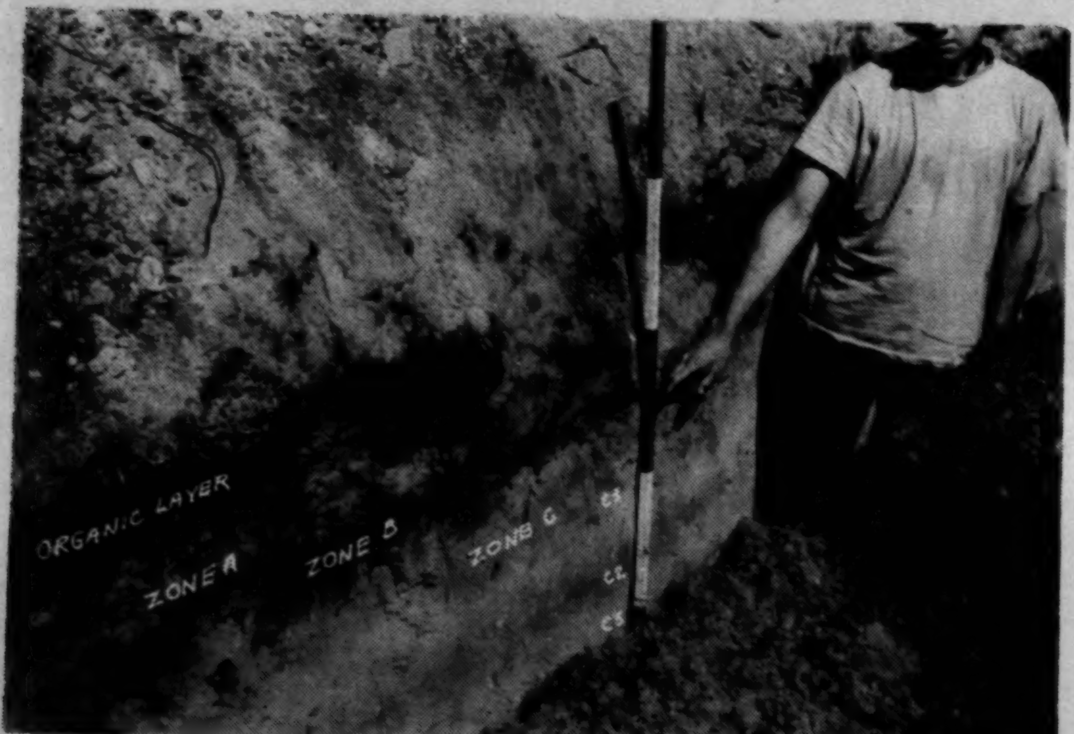
A2
ZONE A
HARDER SITE
UNIT 10S0W
NORTH FACING
PROFILE
SEPT 3, 1969
ZONE B
ZONE C

Plate 5. North-Facing Profile of Excavation Unit 10s0w showing strata at Harder site.


ORGANIC LAYER
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ZONE C
C1
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C3

Plate 6. South-Facing Profile of East Trench showing strata at Harder site.

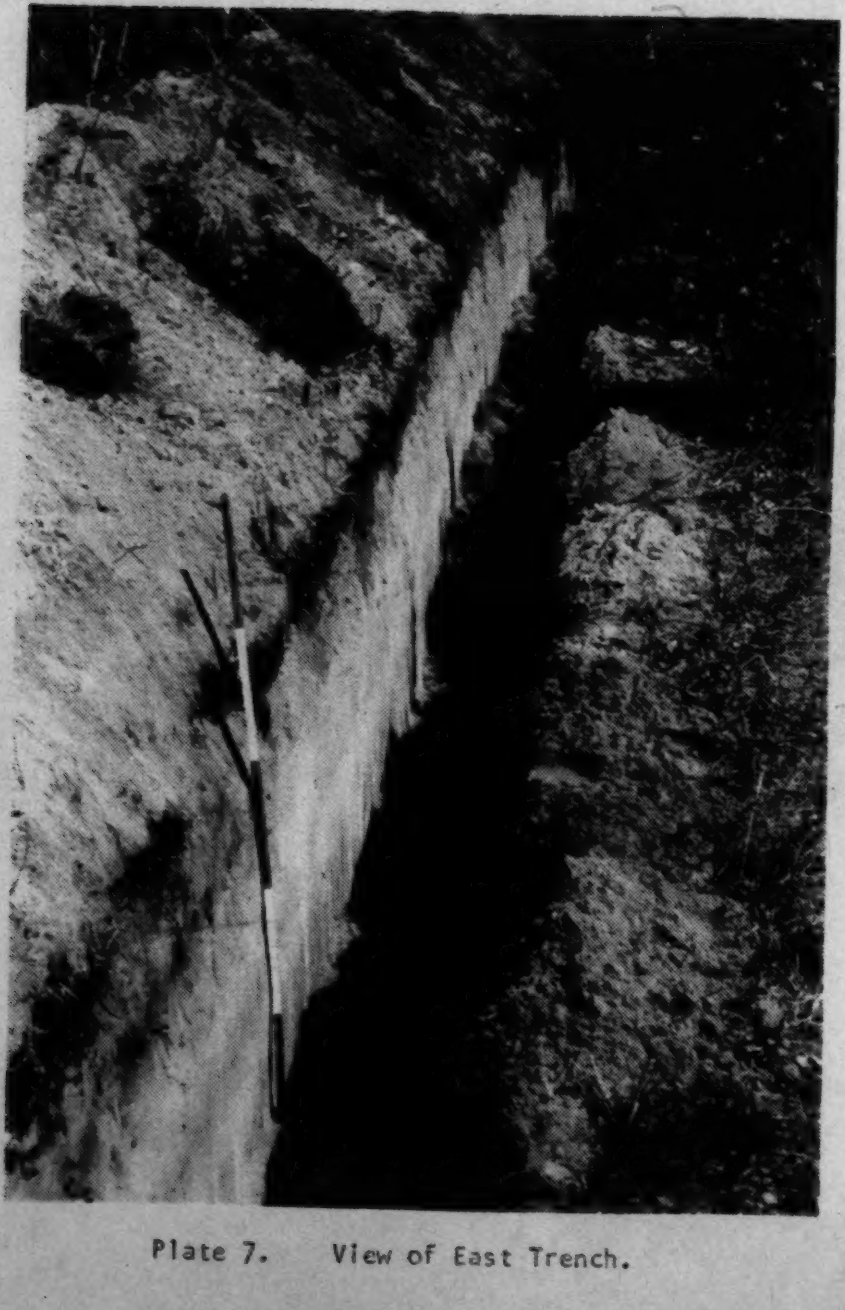

Plate 7. View of East Trench.

Plate 8. Stripping sod off unit 65sow. Note brush cleared at left for excation of outlying unit 105s0w. September 1972.

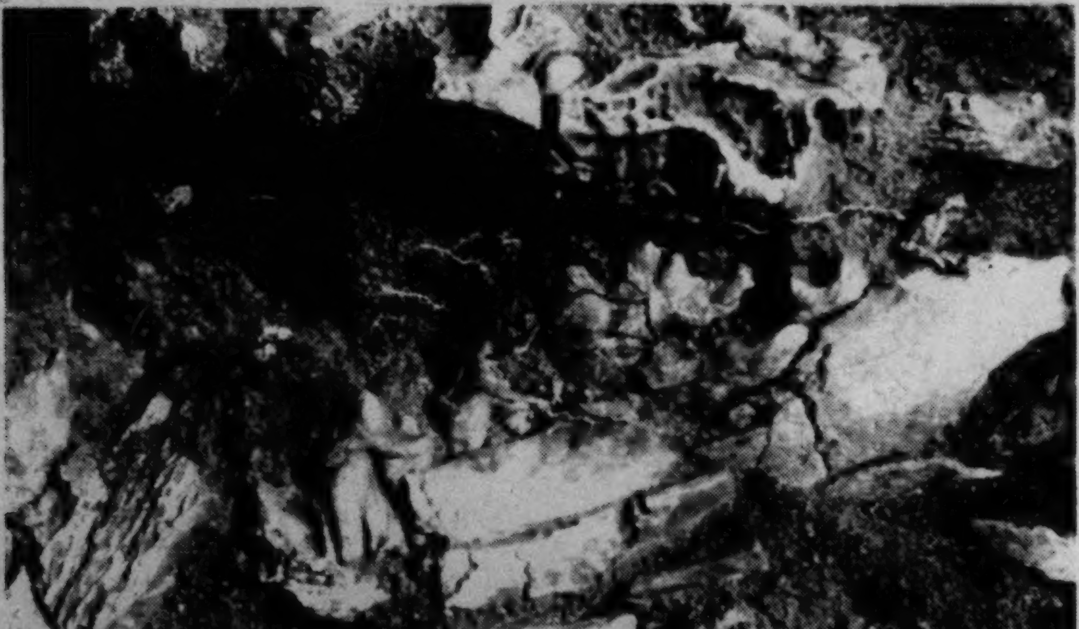

Plate 9. Canid mandible in situ in excavation unit 0w5n.

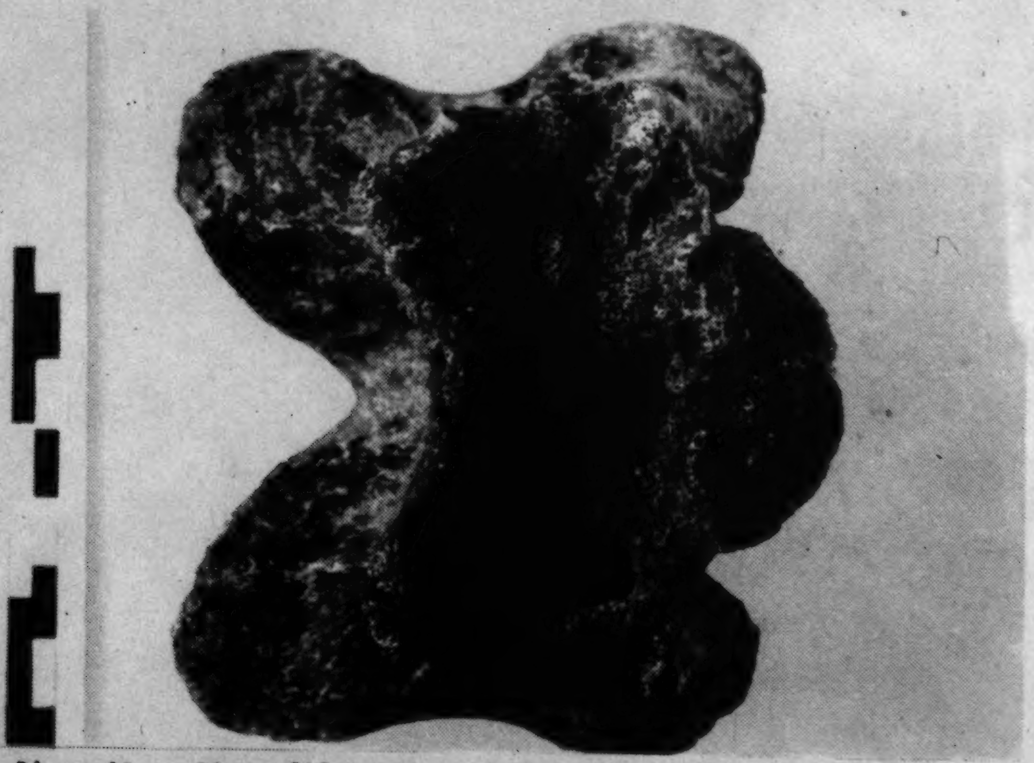

Plate 10. Bison fifth cervical vertebra showing gnaw marks.

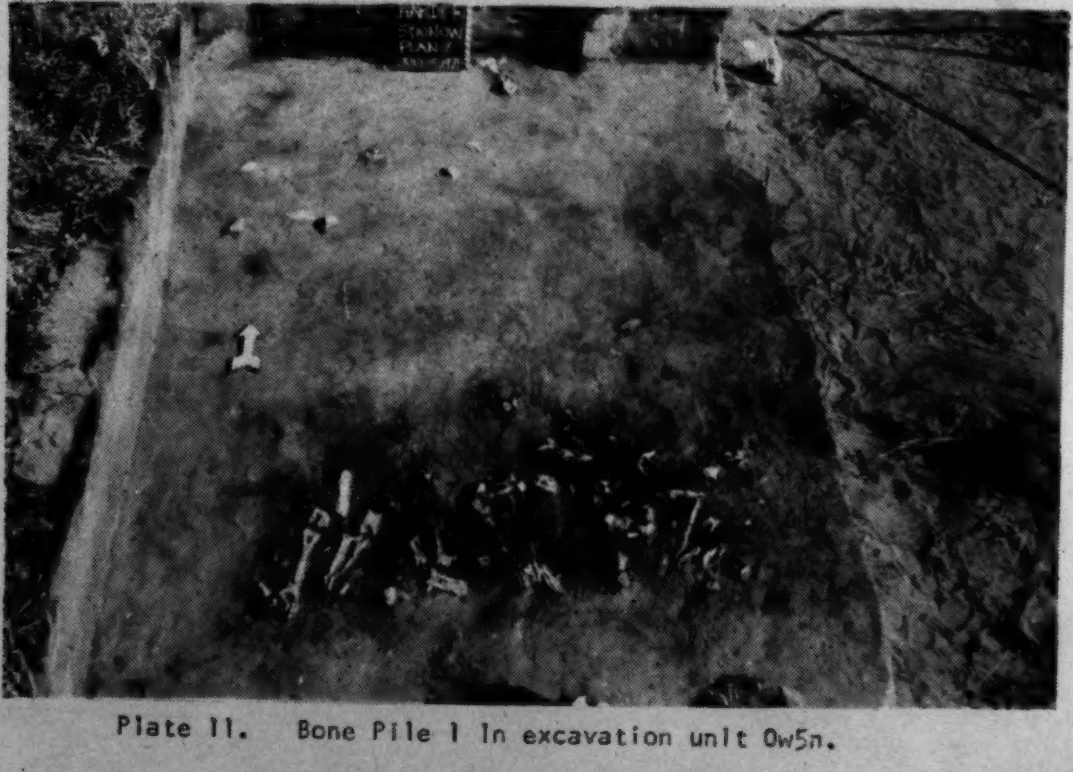

Plate 11. Bone Pile 1 in excavation unit 0w5n.

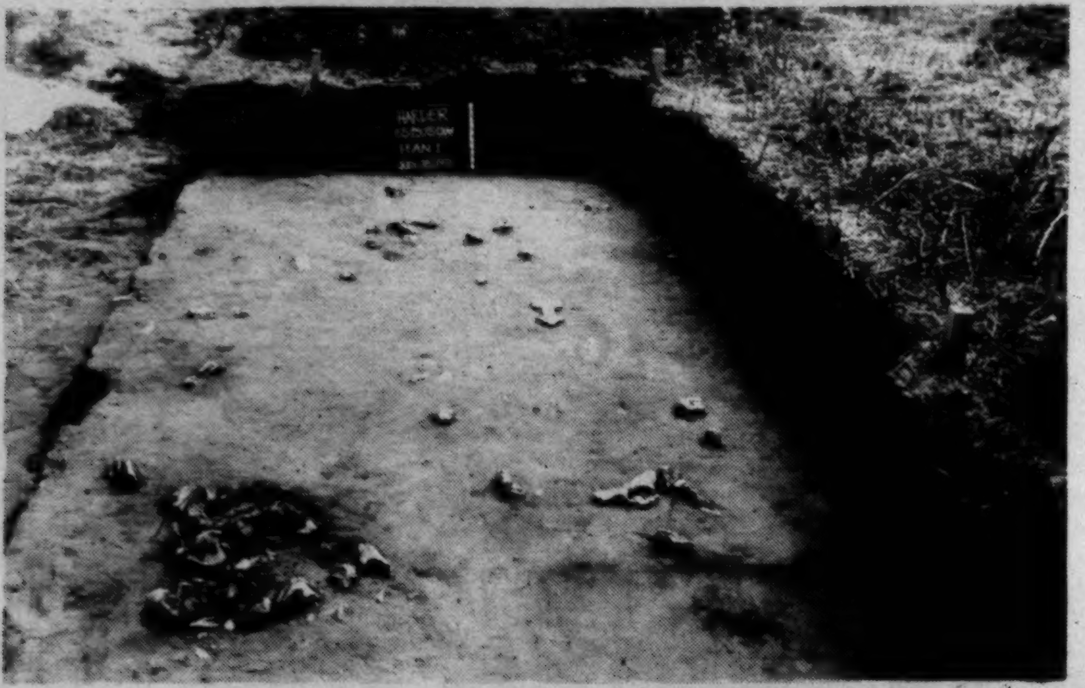
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Plate 12. Bone Pile 11 at left of photo.

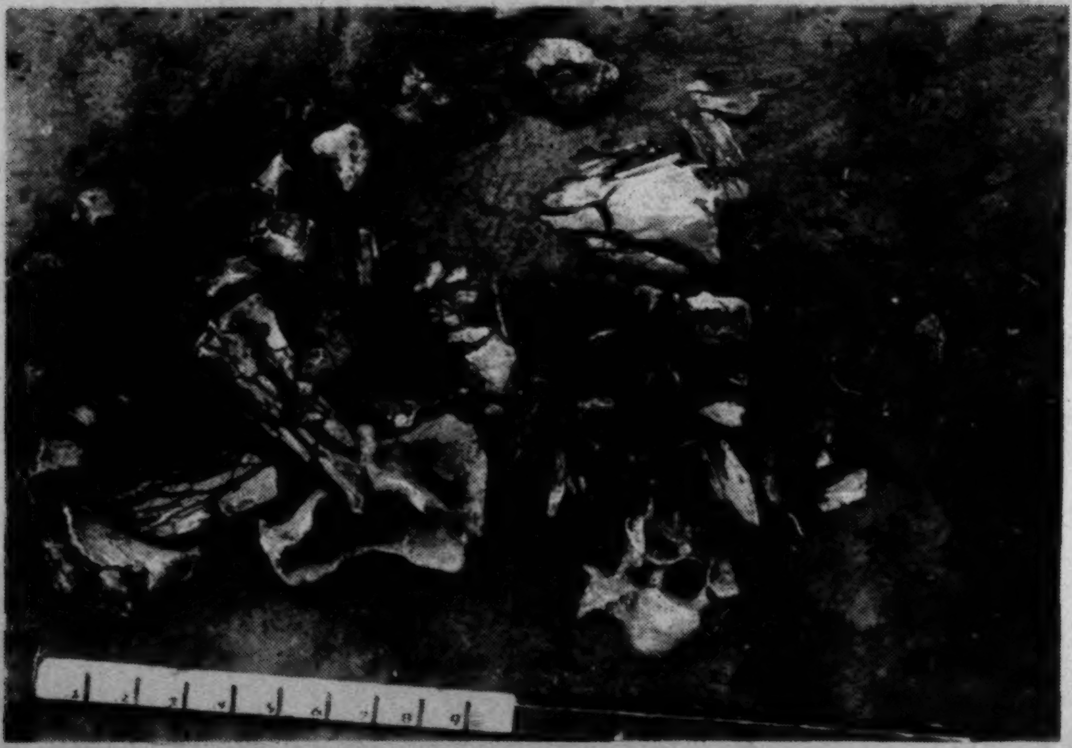

Plate 13. Close up of Bone Pile 11.

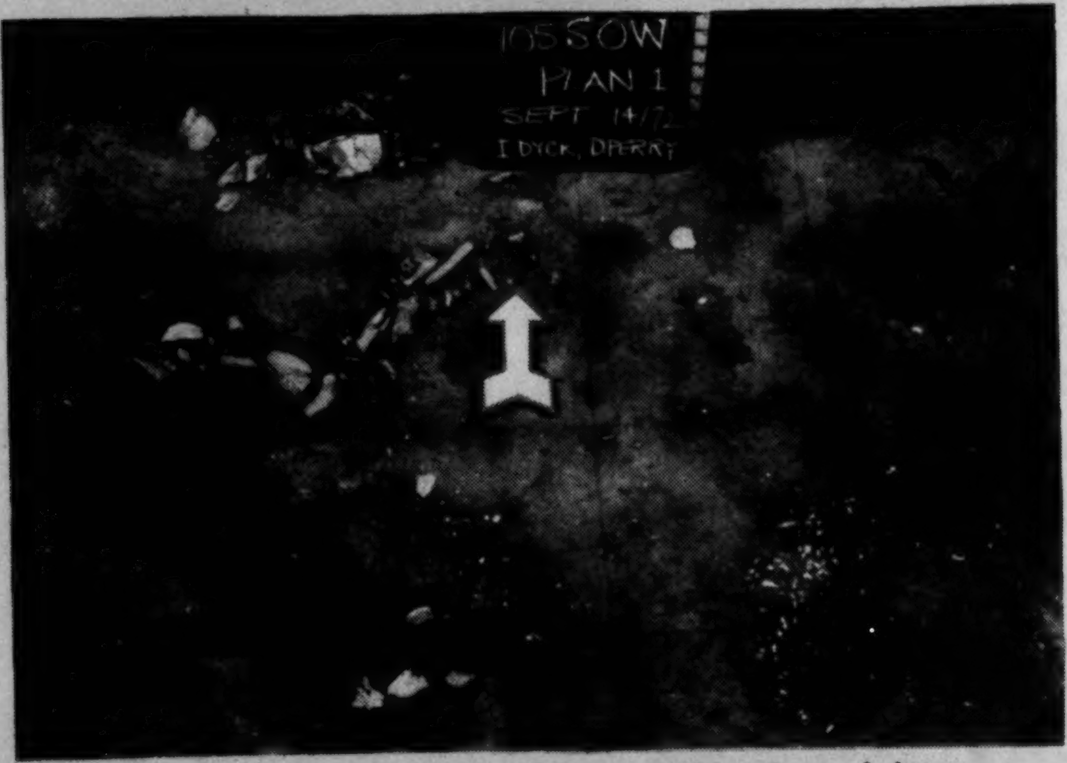
105 SOW
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Plate 14. View of Pocket of Charred-white Bones I in bottom right quarter of photo with black hearth area to right.

WEST FACING
PROFILE
AUG 15, 1979

Plate 15. View of Pocket of Charred-white Bones II in centre of foreground.

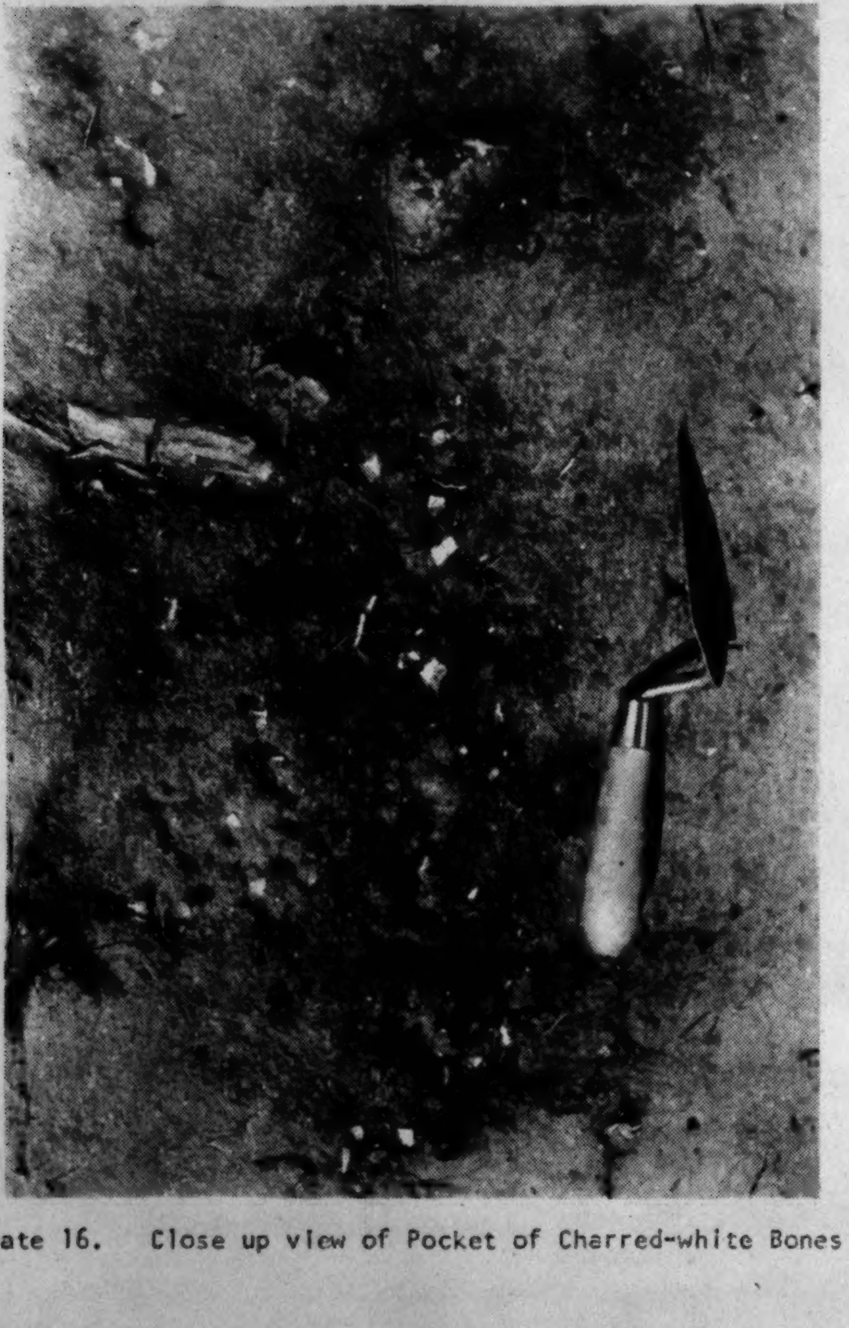

Plate 16. Close up view of Pocket of Charred-white Bones 11.

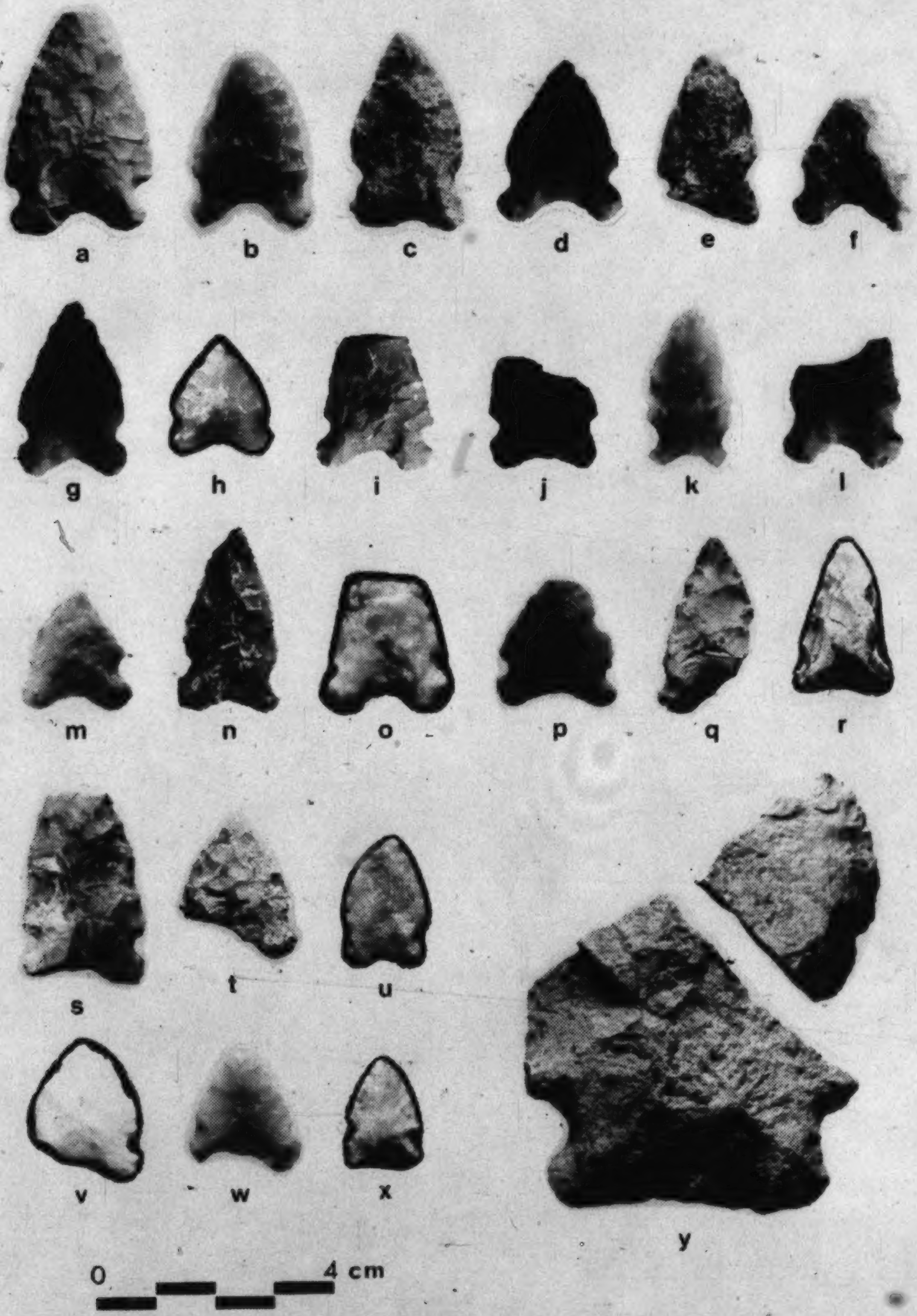
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Plate 17. Projectile Points.

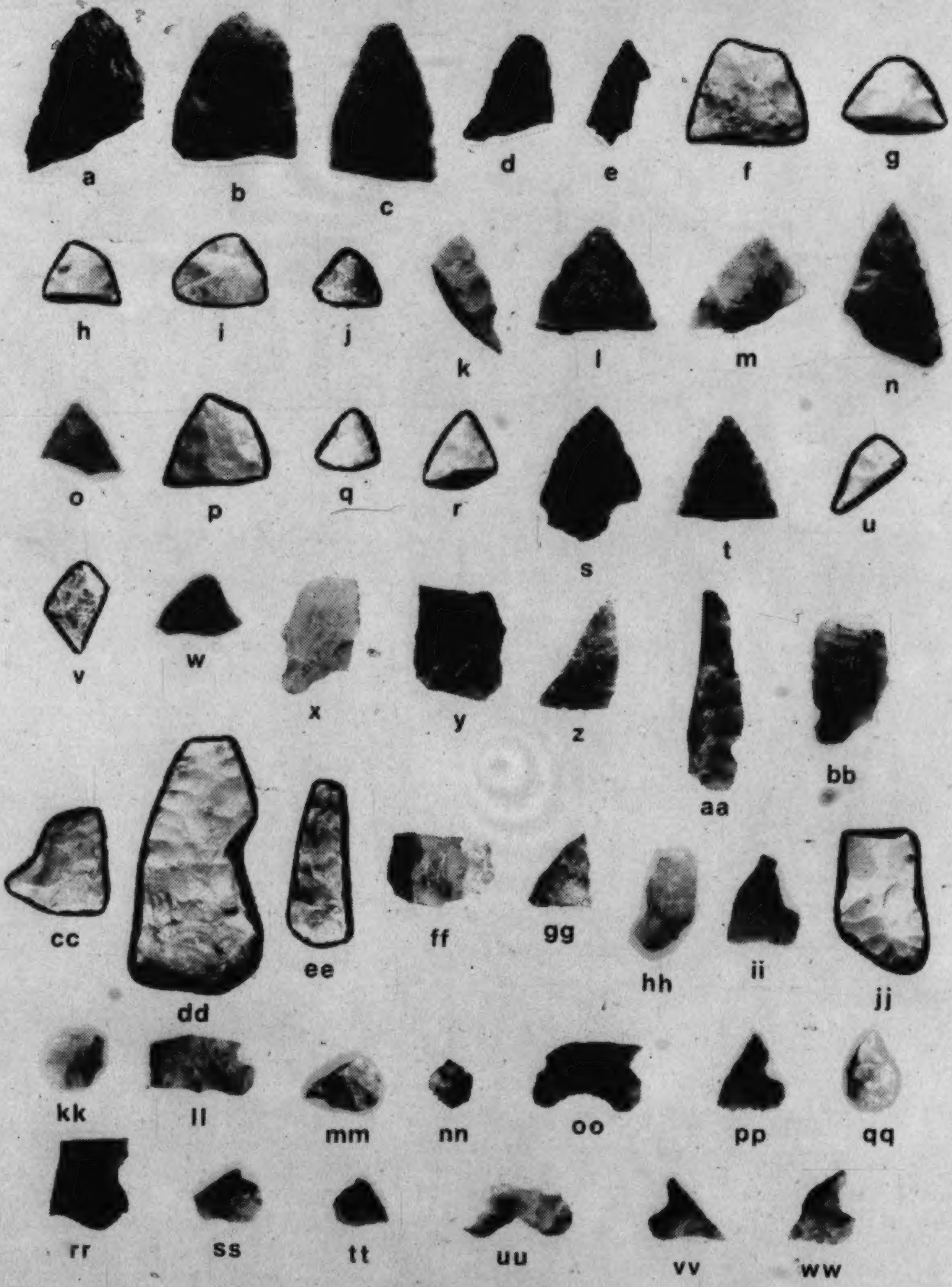
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Plate 18. Projectile Point fragments.

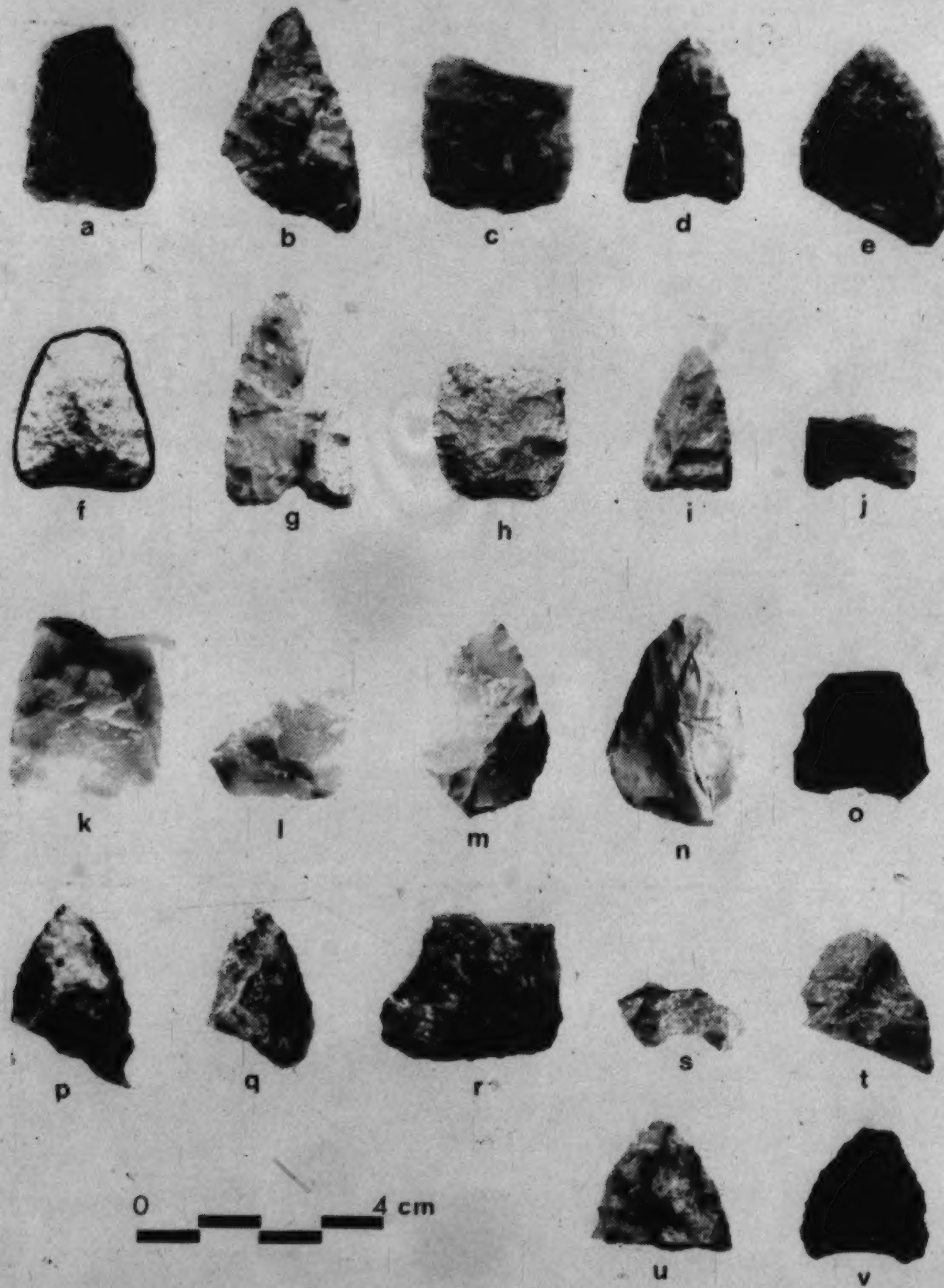
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Plate 19. Projectile Point Preforms.

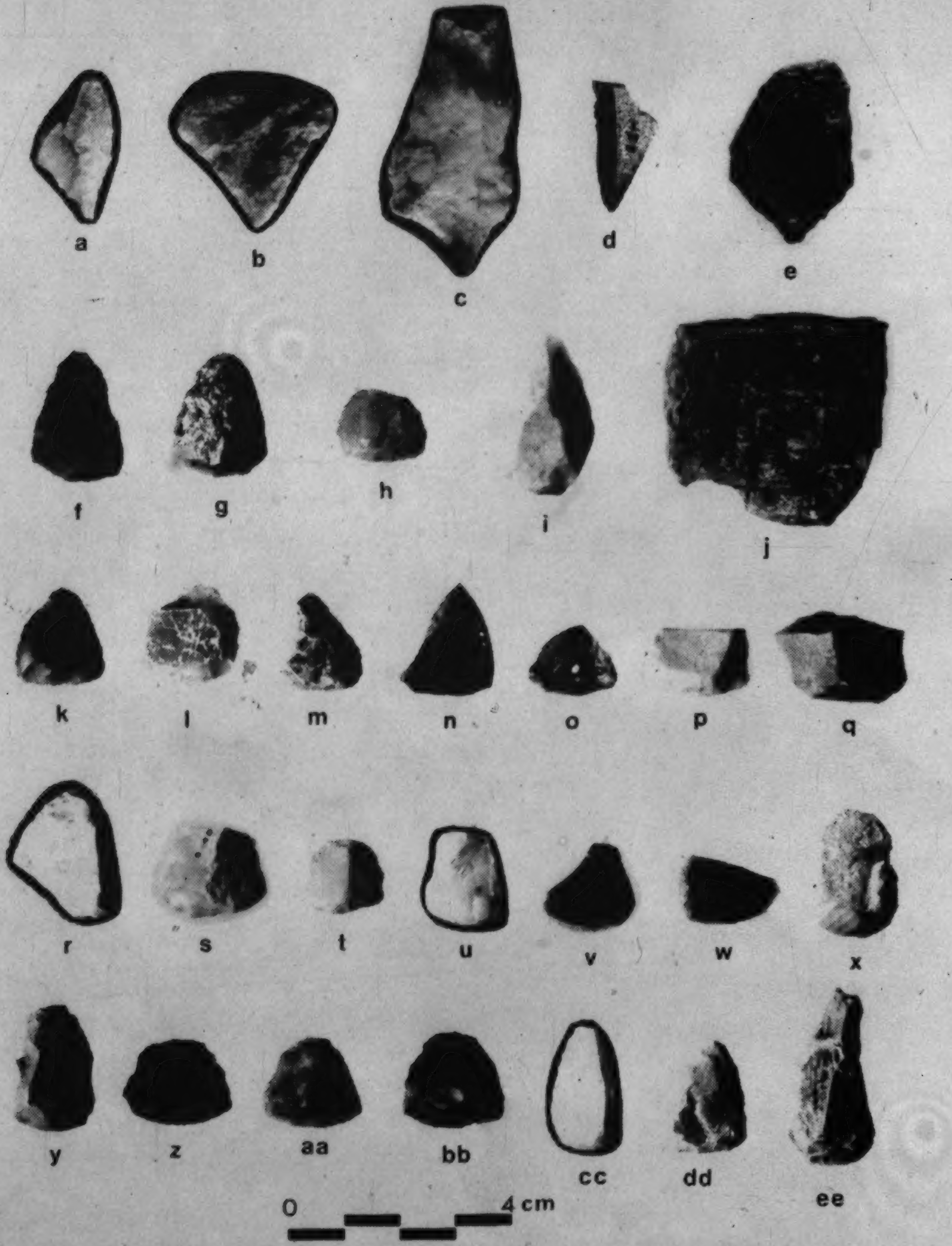
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Plate 20. Perforators, a-e; Small End Scrapers, f-ee.

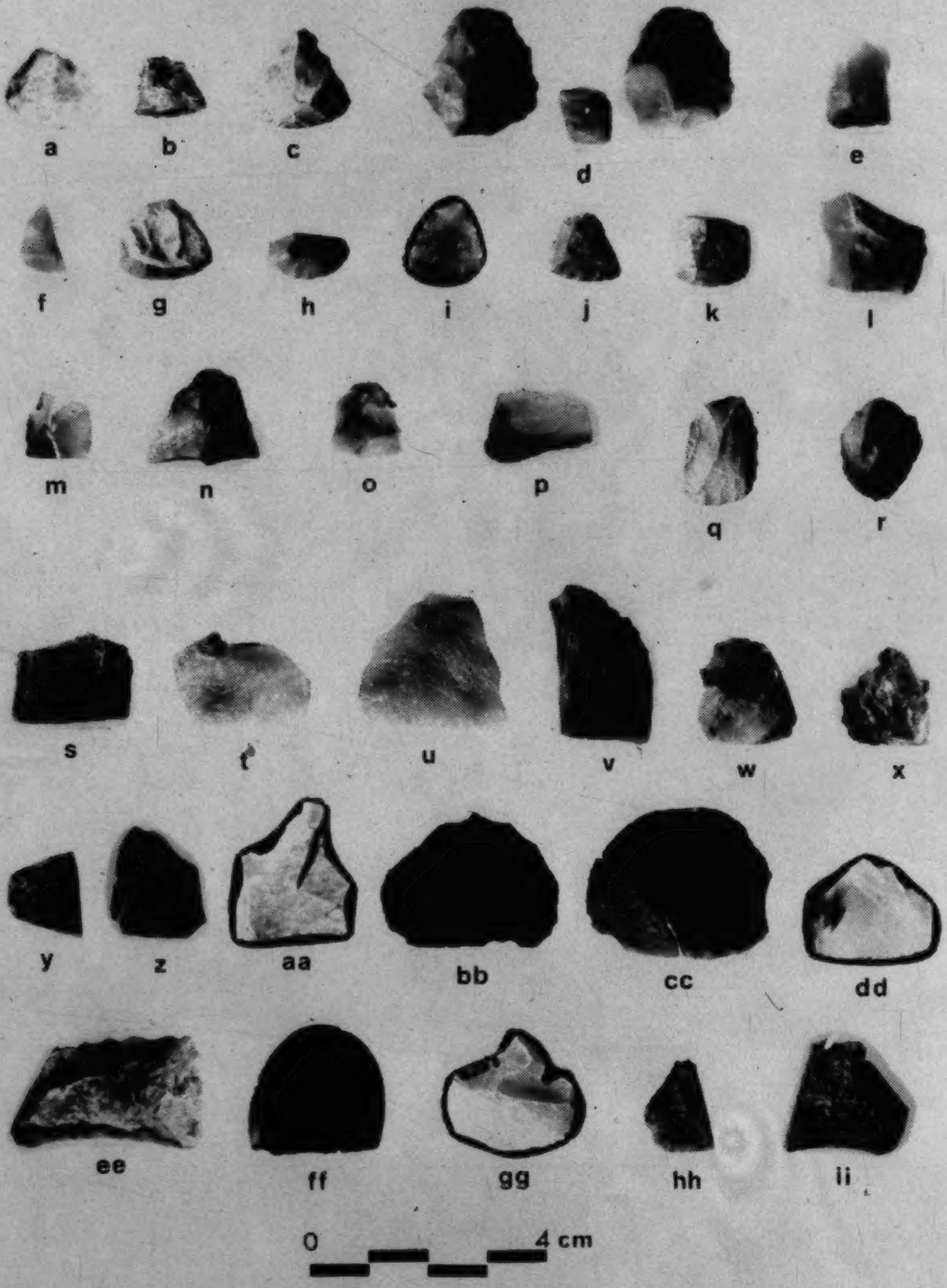
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Plate 21. Small End Scrapers, a-r; Thin Uniface Knives, s-ii.

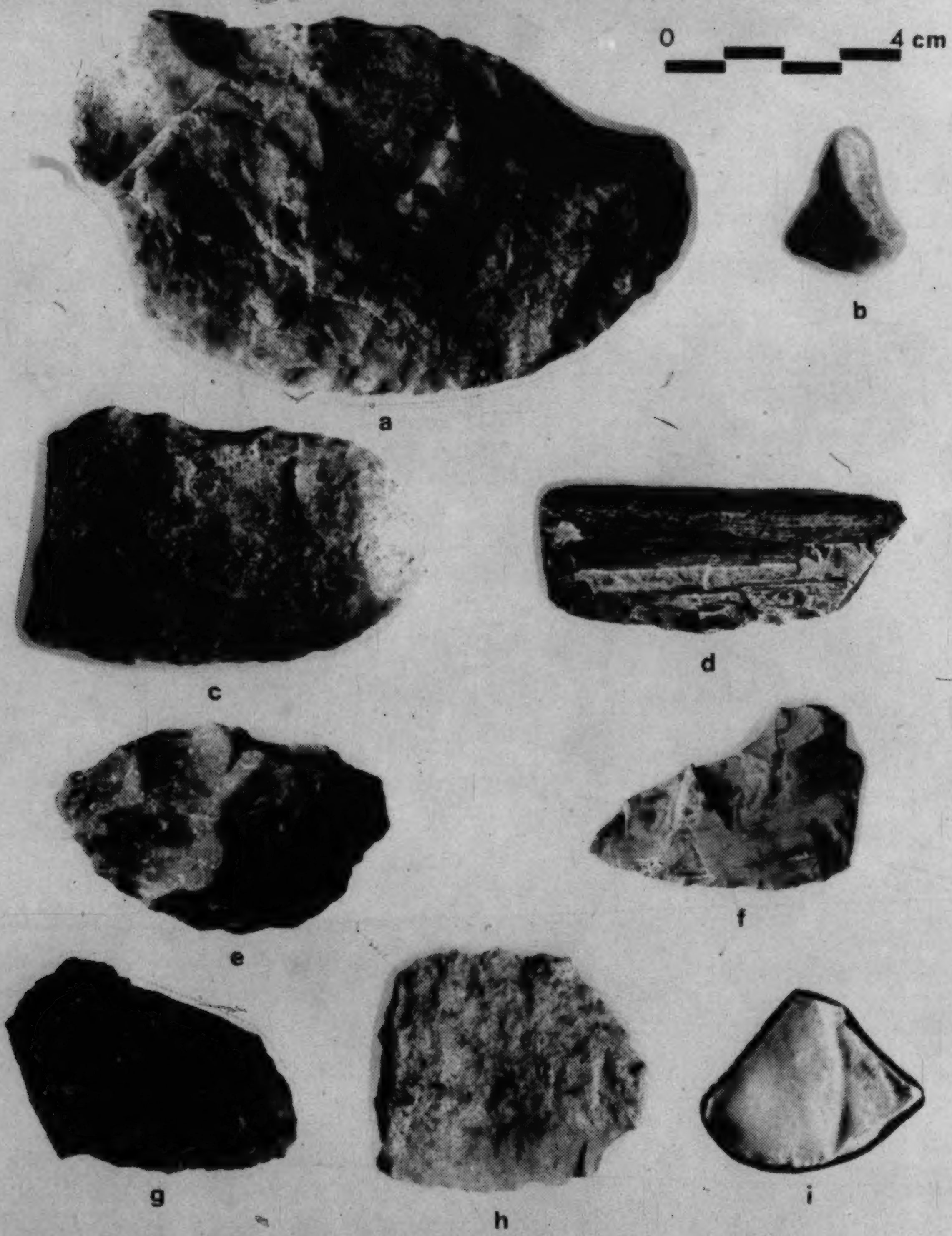
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Plate 22. Biface Knives, a-f; Residual Retouched Items, g-i.

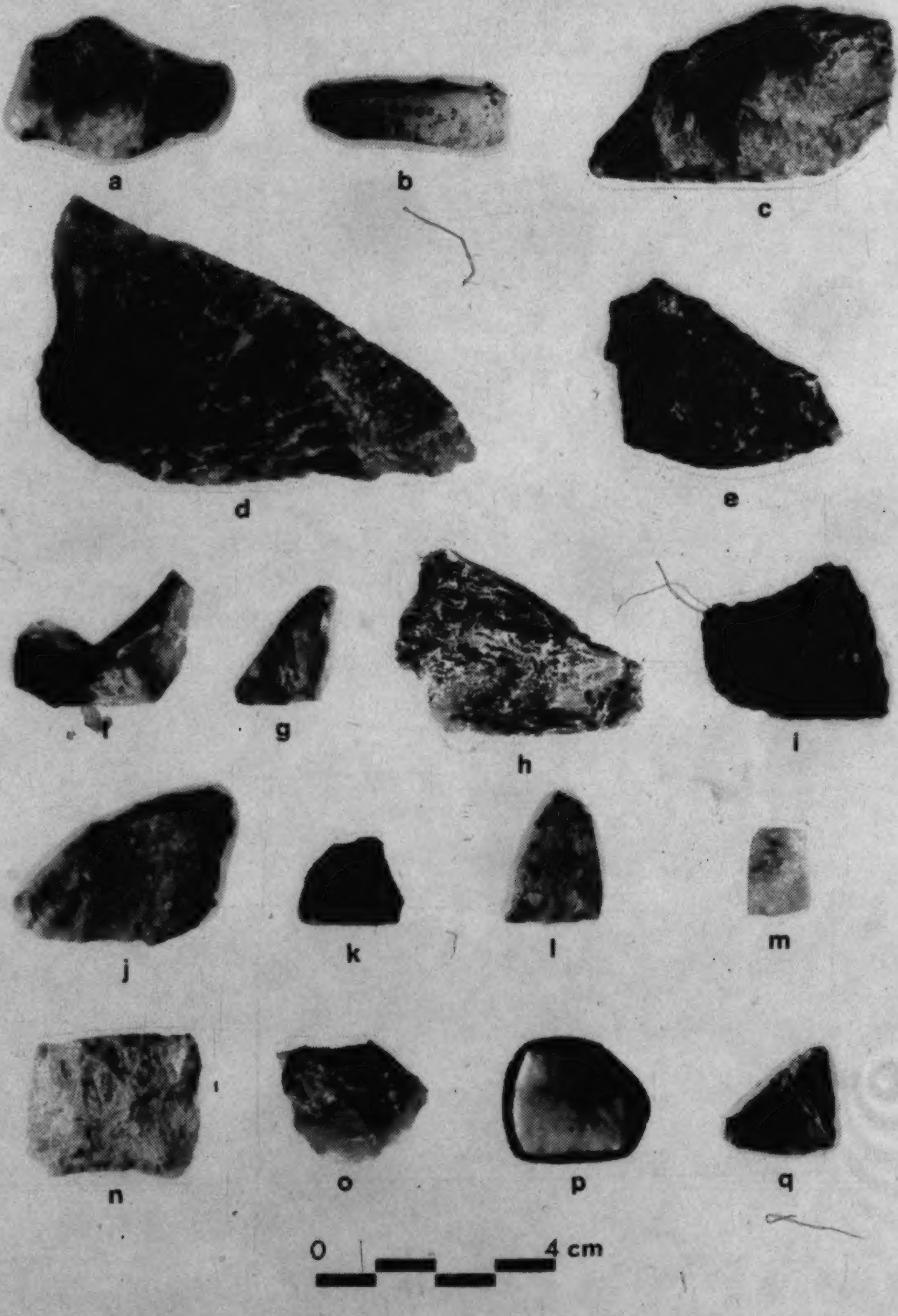
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Plate 23. Residual Retouched Items.

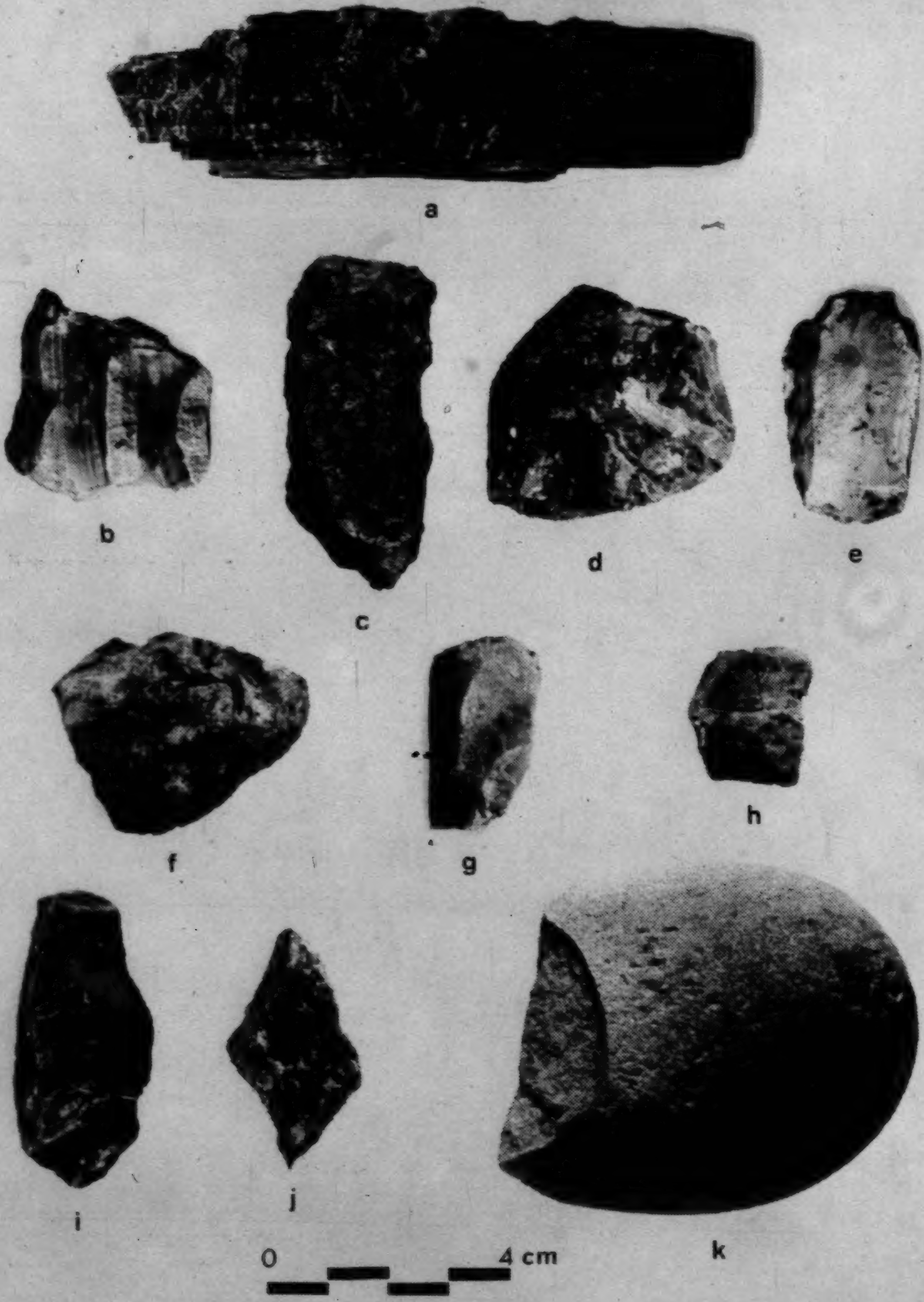
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Plate 2[illegible] Cores, a-j; and Hammerstone, k.

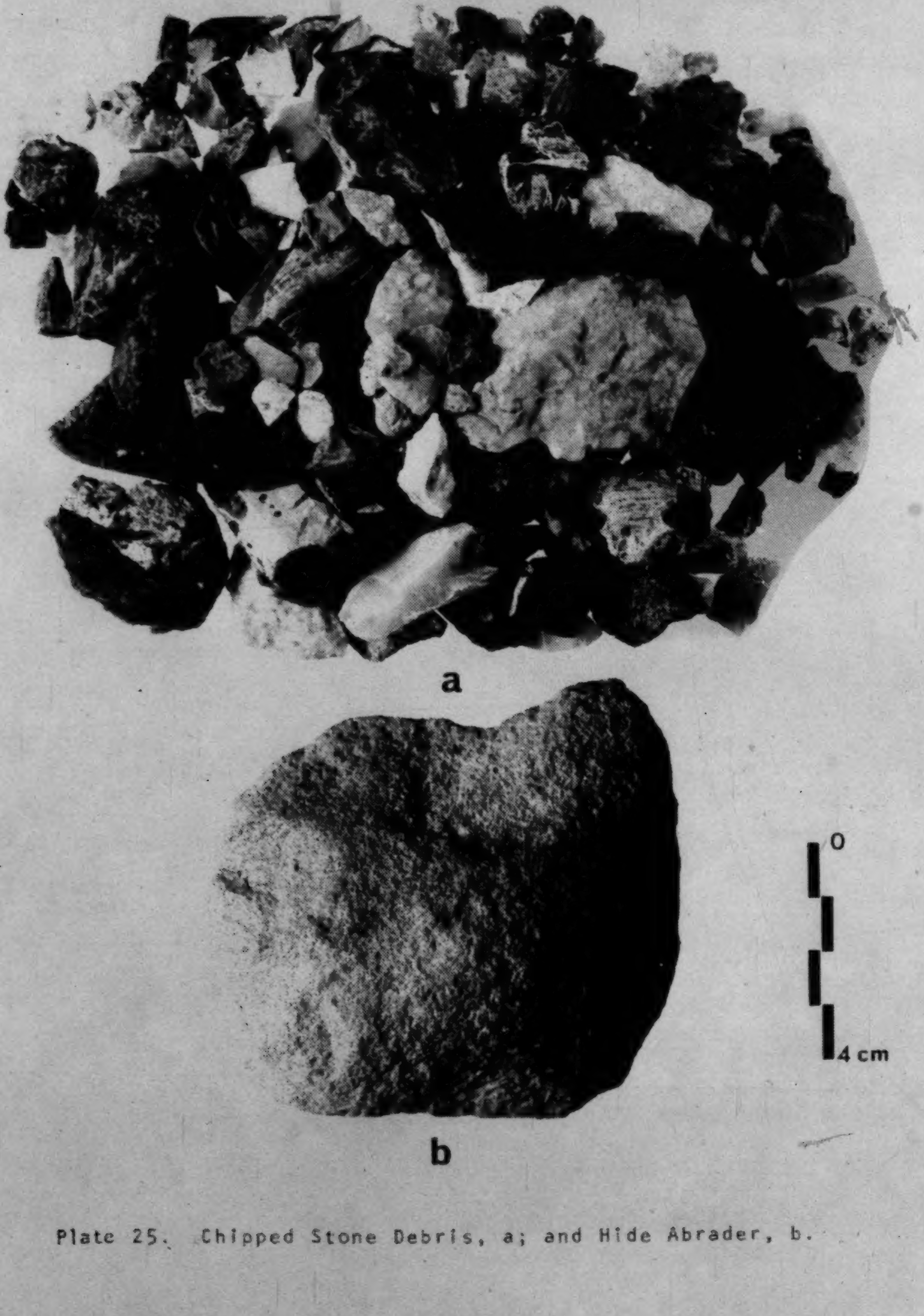

Plate 25. Chipped Stone Debris, a; and Hide Abrader, b.

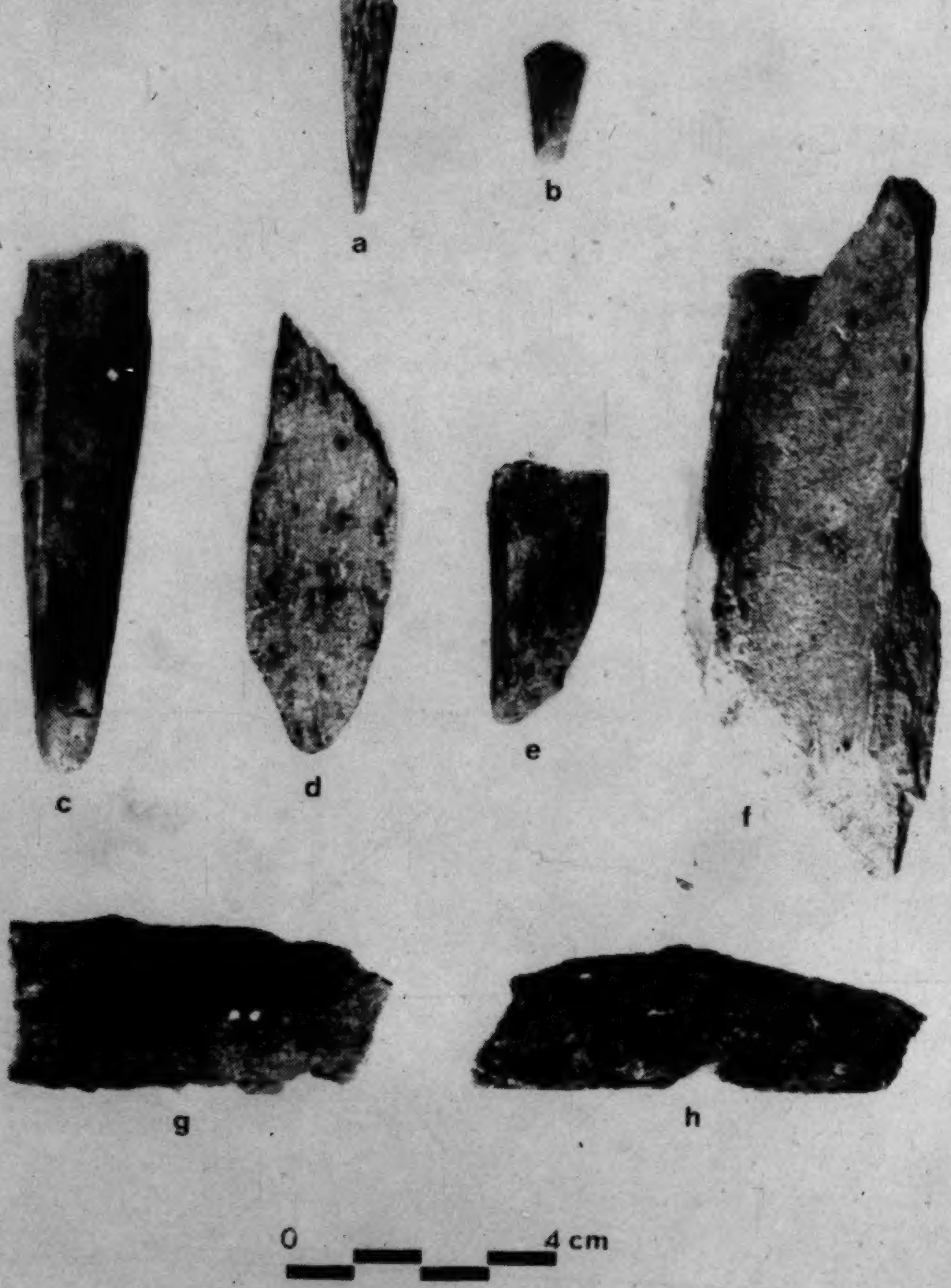
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Plate 26. Bone Tools, a-f; Bone with cut, g, and chop, h, marks.

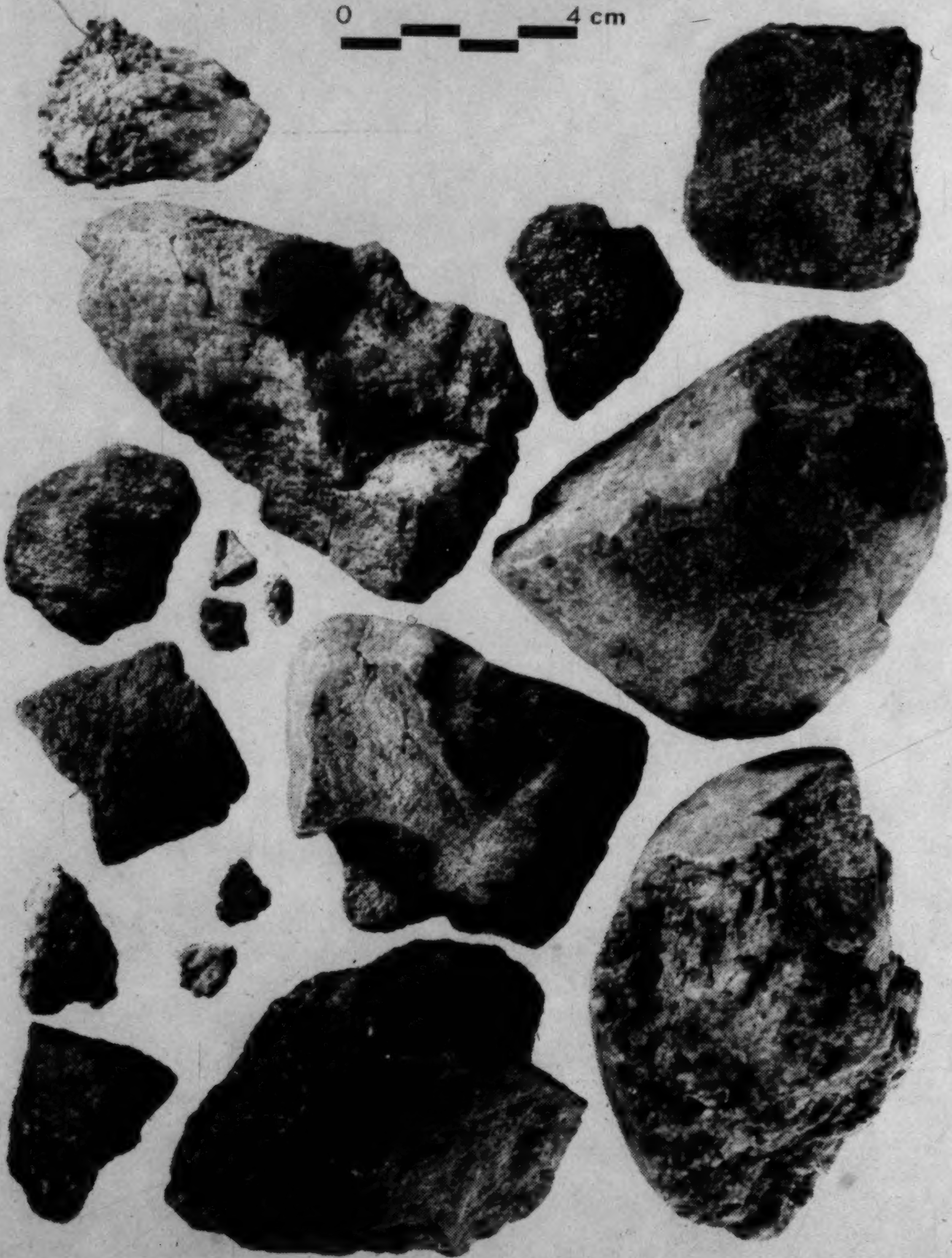

Plate 27. Sample of Coarse Stone from Unit Ow5s.

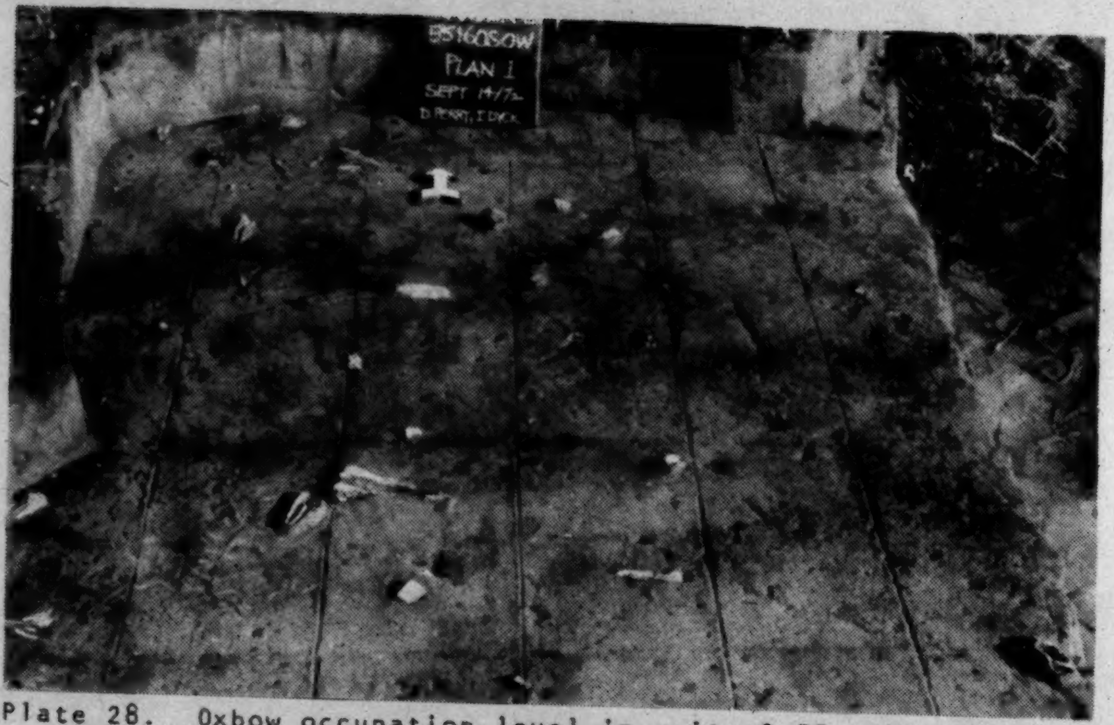
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Plate 28. Oxbow occupation level in units 0w55s and 0w60s showing area of low contrast colour variations.

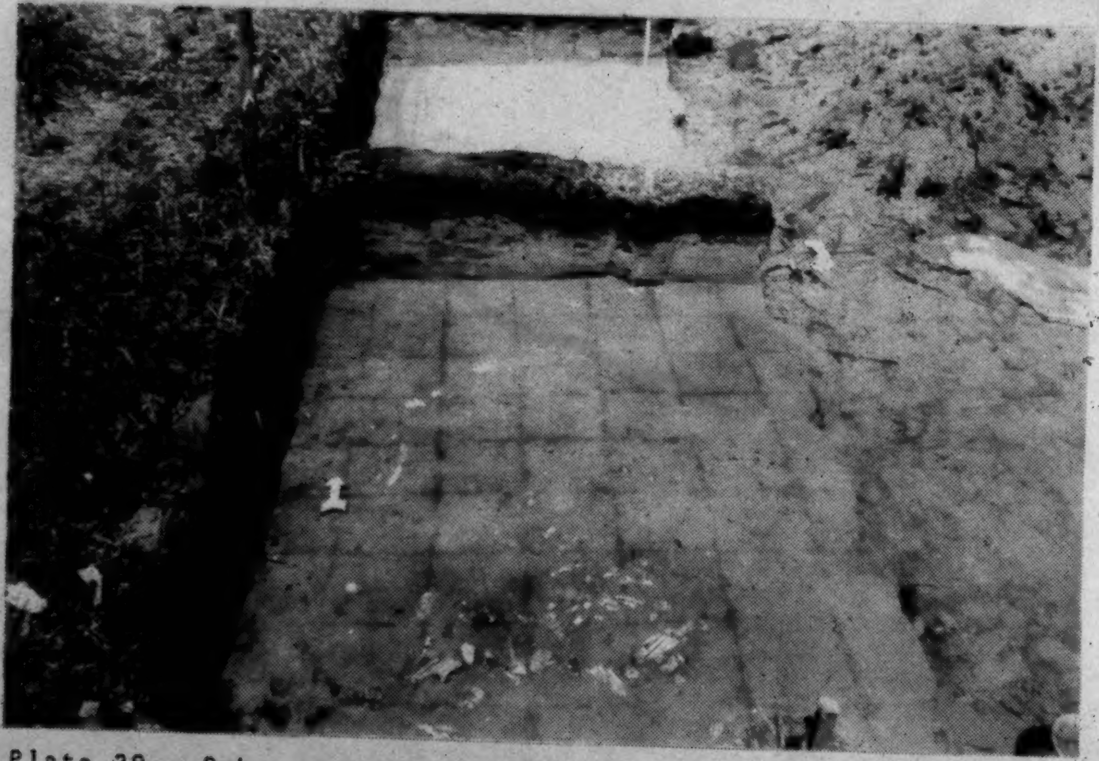

Plate 29. Oxbow occupation level in units 0w10n and 0w15n showing high colour contrast in adjoining units.

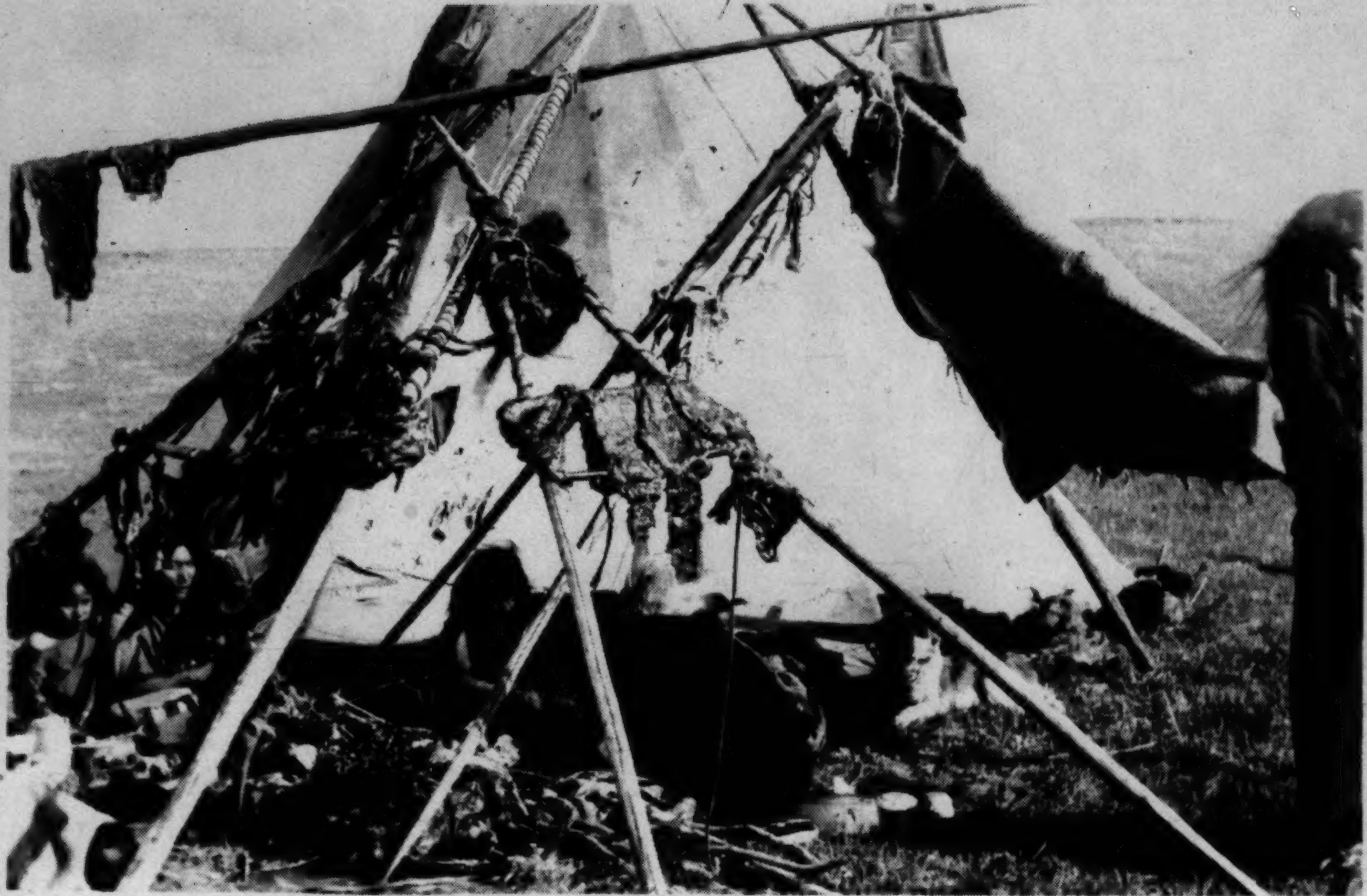

Plate 30. Historic photograph, 'Migrating Indians at Calgary, Alberta, c. 1886', showing occupation debris around perimeter of tipi / *The Public Archives of Canada*.

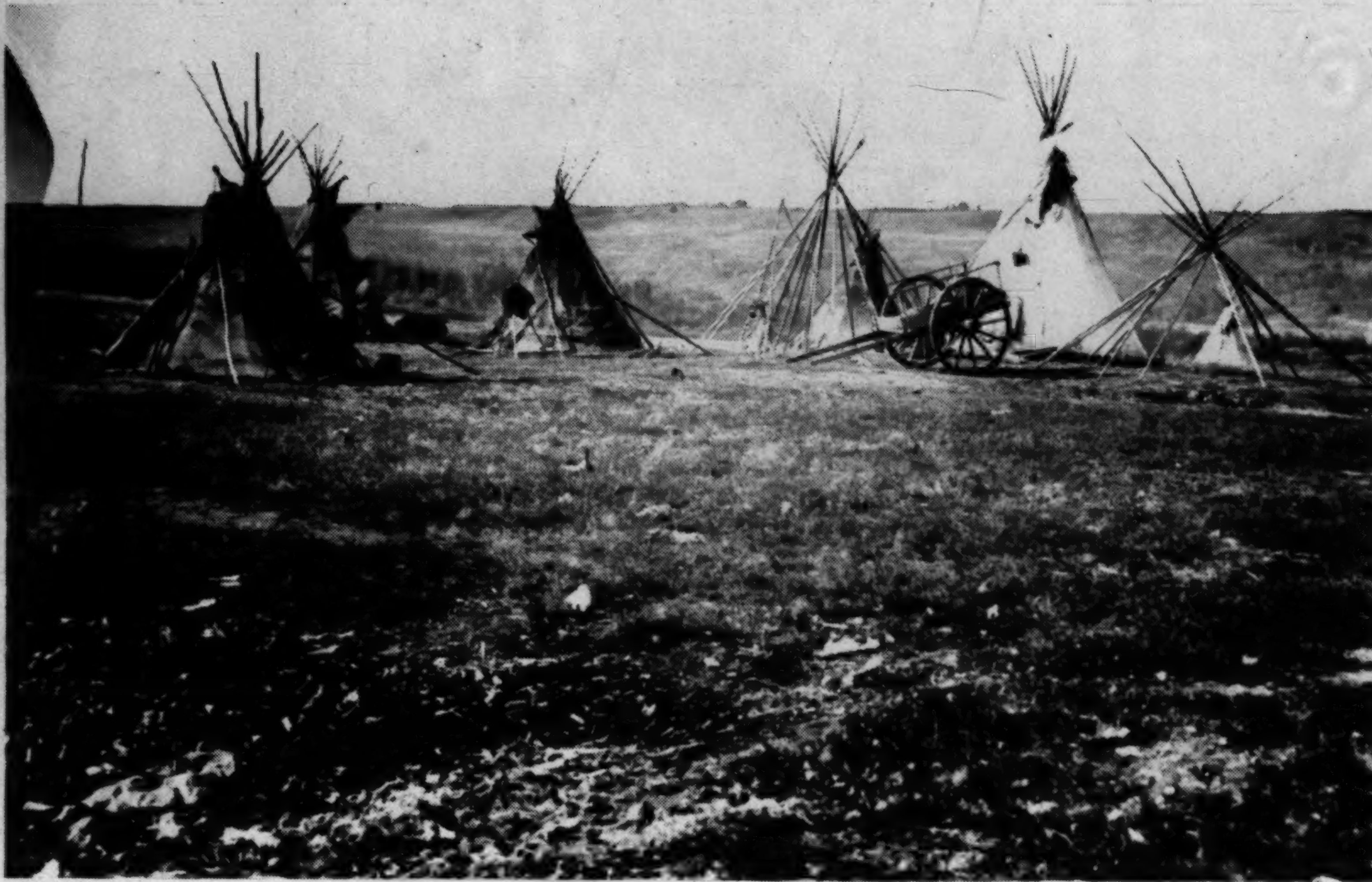

Plate 31. Historic photograph, 'Camp at Elbow of the North Saskatchewan, Sept., 1871', showing bone refuse pile in foreground / *The Public Archives of Canada.*

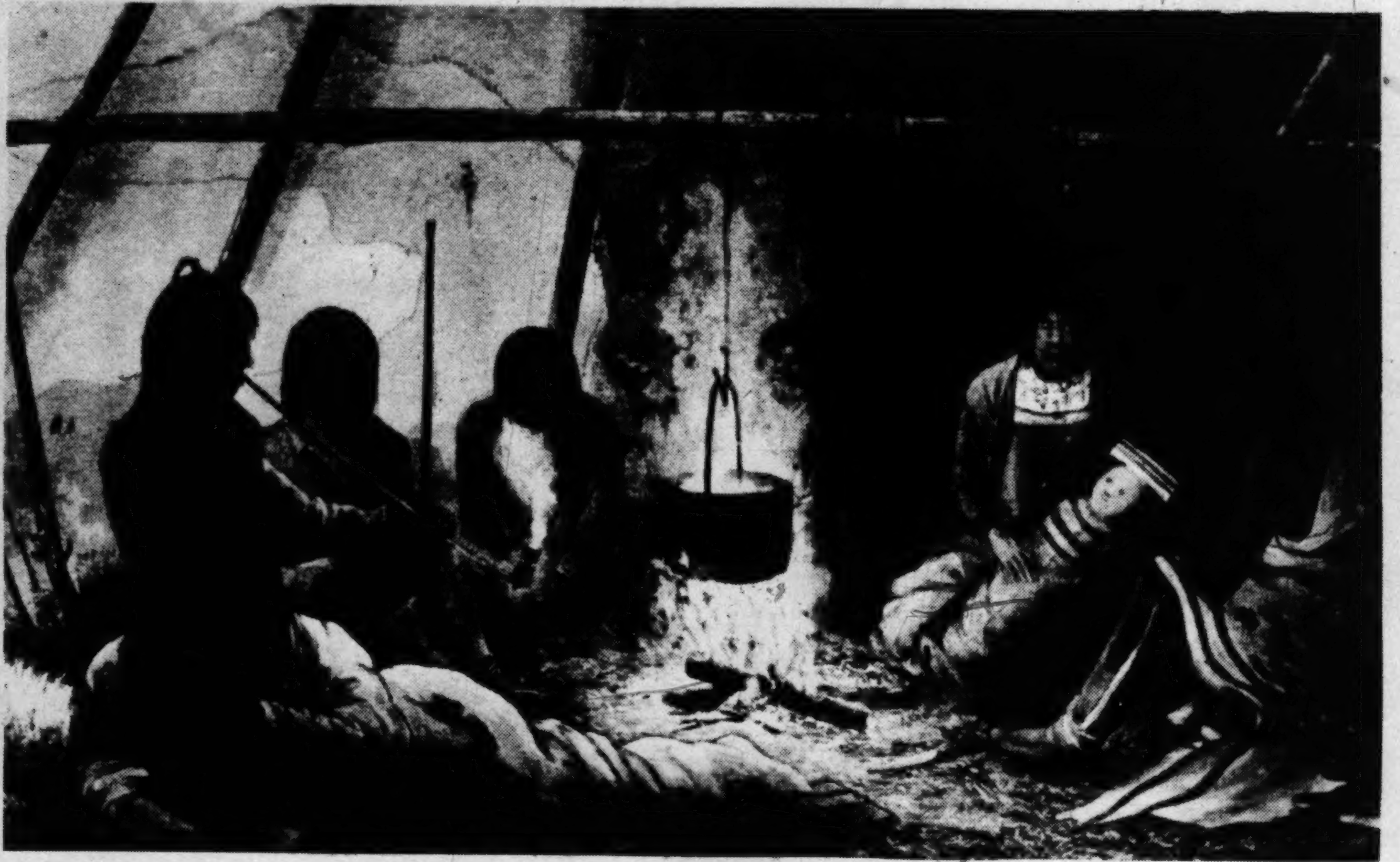

Plate 32. Drawing of the interior of a Cree Indian tent, March 1820, by Lieut. Hood (from Franklin 1970)/ *Saskatchewan Museum of Natural History.*

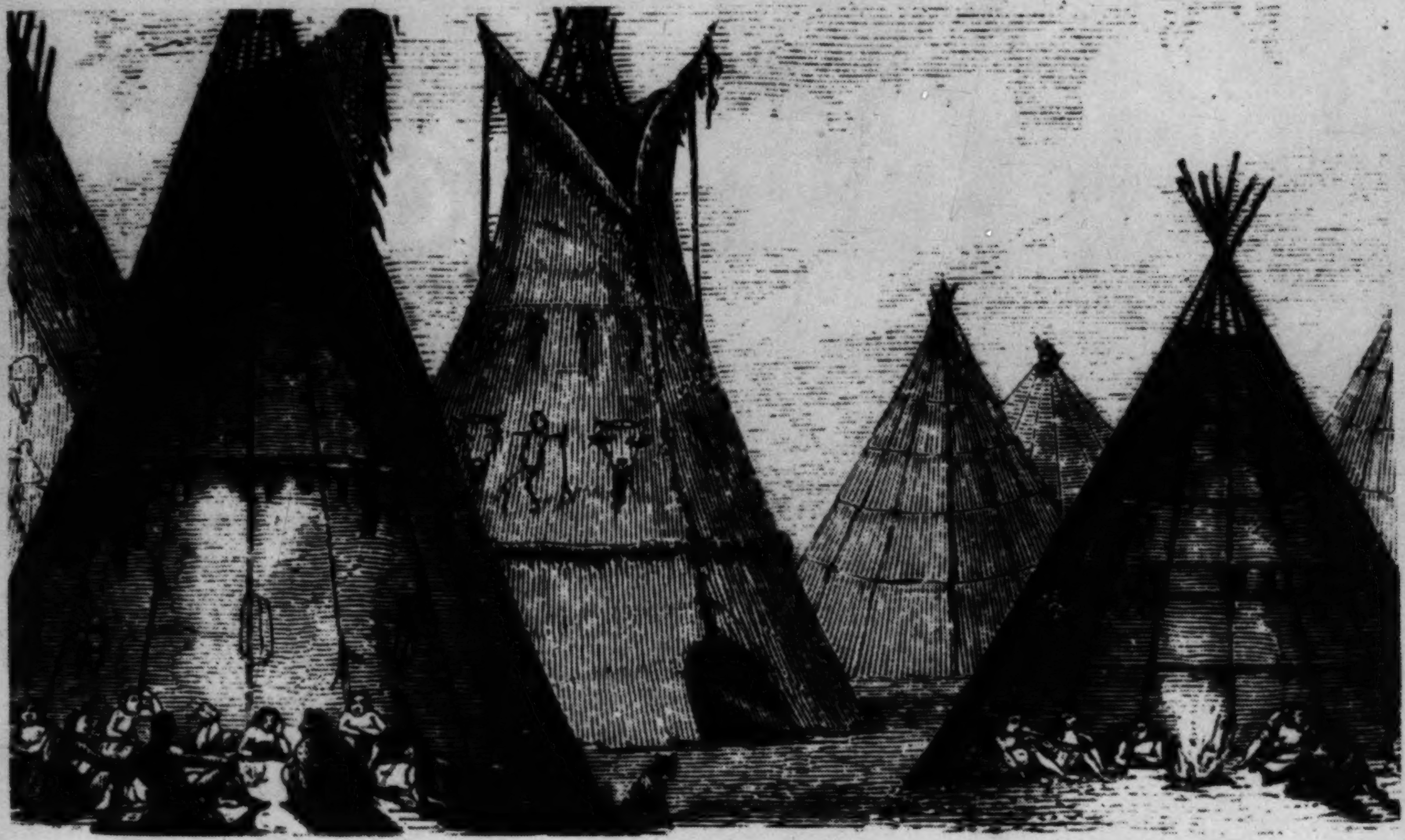

Plate 33. Interiors of Cree skin tent and Ojibwa birch bark tent, October 1858 (from Hind 1971) / *Saskatchewan Museum of Natural History*.

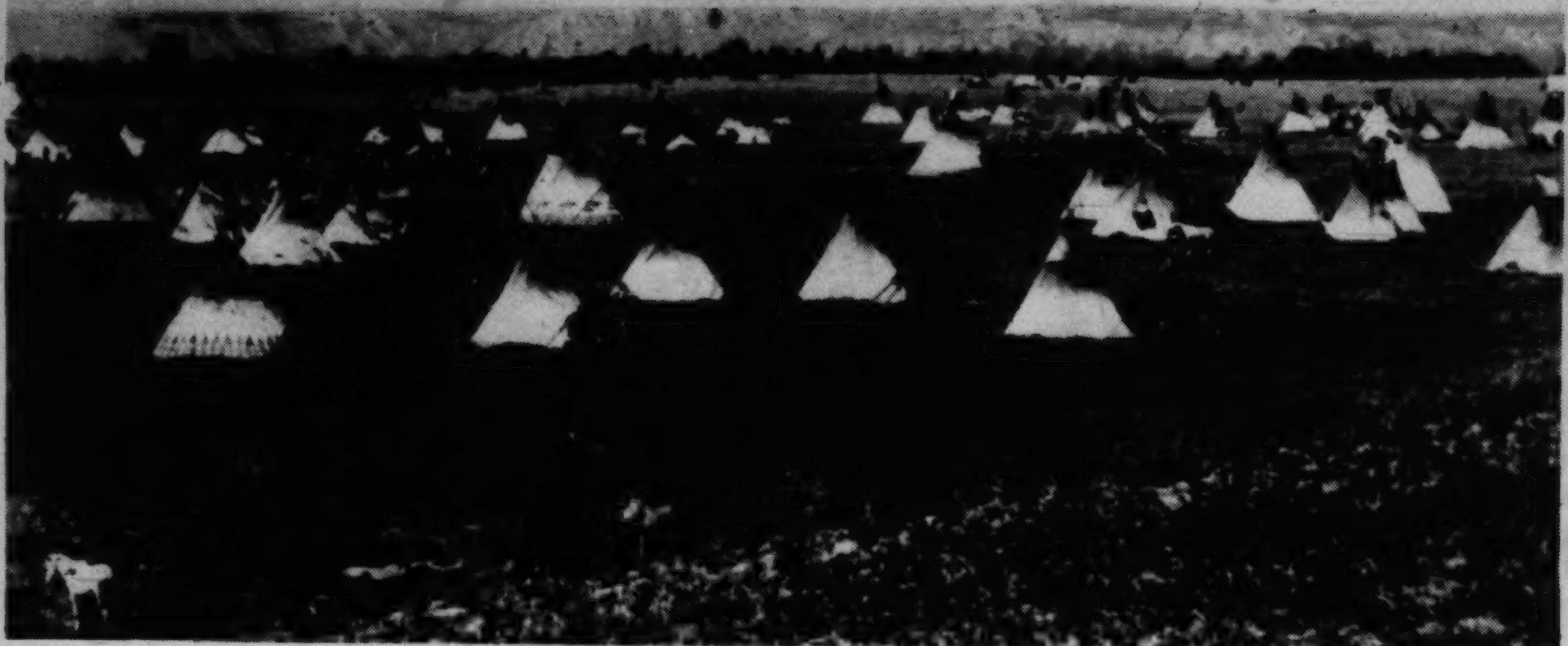

Plate 34. Historic photograph, 'Camp of Piegan Indians in Pincher Creek Country, c.1889', showing sundance ceremonial structure, right centre / *Manitoba Archives*.